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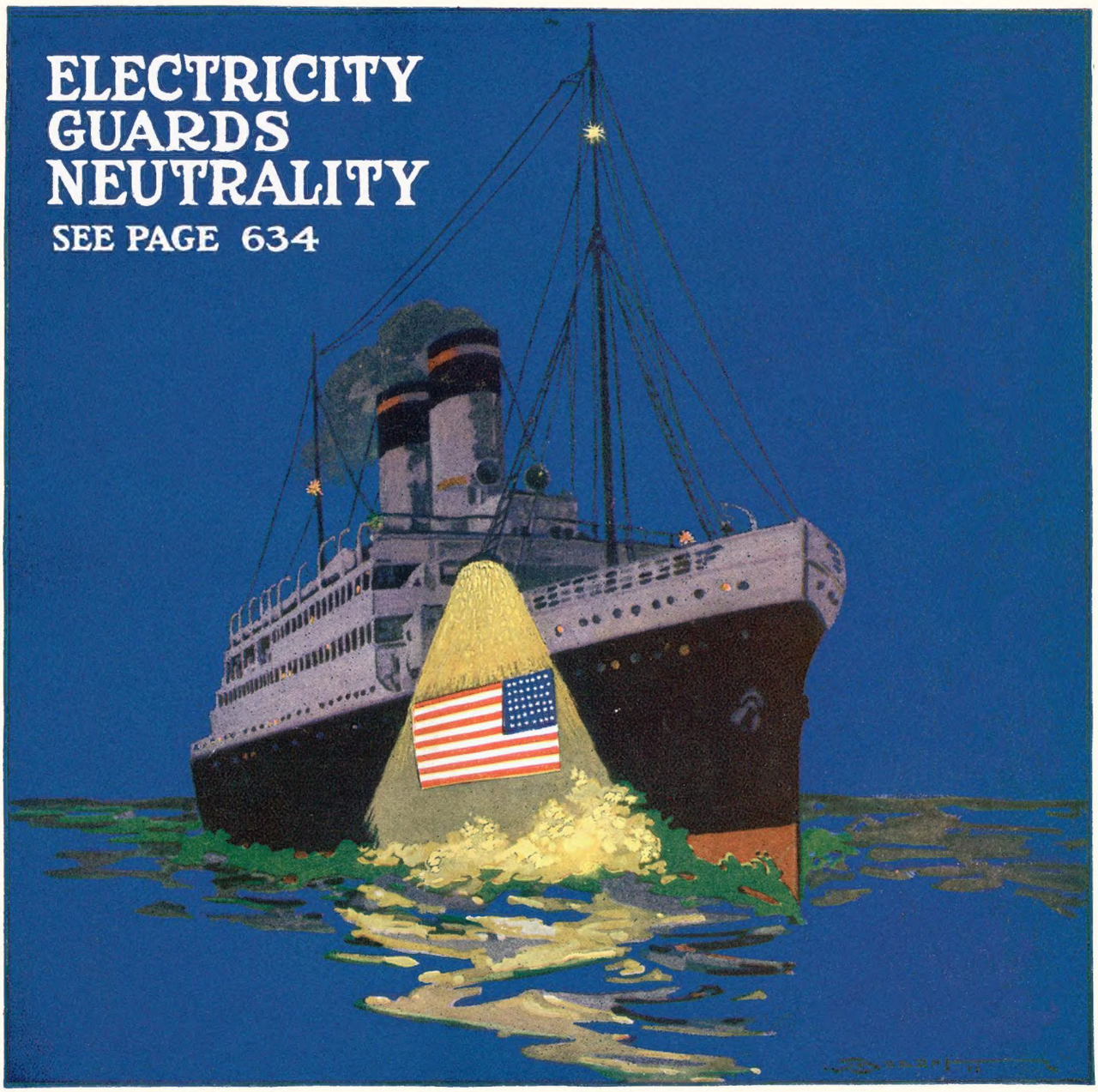
The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED



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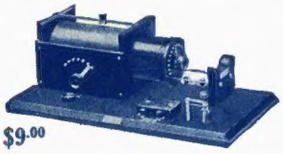

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Our COMBINATION TYPE INDUCTIVE TUNER, Fixed Condenser, of exact capacity for this station, our No. C-22 Crystal Detector (having a lateral and horizontal motion making it easy to adjust), controlled by a rotary switch placed so as to permit a TEL-RADION Permanent Detector to be connected to this station if so desired, without changing the wiring. Complete as described. . . **$9.00**

With a set of 2,000 Ohm D. P. Receivers, Headband and cord **$12.95**

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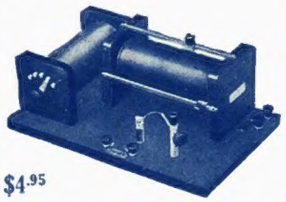

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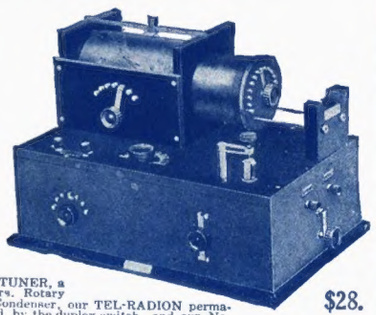
This station is complete and includes the following instruments mounted in a birch cabinet, highly finished in mahogany.



$28.

Our COMBINATION TYPE INDUCTIVE TUNER, a seven-point loading coil, capacity 500 meters. Rotary Variable condenser of 43 plates. A Fixed Condenser, our TEL-RADION permanent Wireless Detector, which is controlled by the duplex switch, and our No. C-22 Crystal Detector. A short-circuiting switch is provided to protect the detectors from burnouts if a transmitting station is employed.

Complete with a 2,000 Ohm Brandes Superior Head Set **$28.00**

Constructed entirely of Mahogany **$30.** Complete parts for this station (less phones) $20

Complete with AERIAL INSULATORS, 100 AMP. LIGHTNING SWITCH, LEADIN, GROUND WIRE and GROUND CLAMP. With a 2,000 Ohm Brandes Superior Head Set. Price **$43.50**

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WITH THIS IMPROVED INSTRUMENT WE RIVAL THE HIGHEST PRICED AND MOST COMPLICATED DETECTOR ON THE MARKET.

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Take advantage of this offer AT ONCE as the number is LIMITED.

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"I have always received such fair treatment and such good value from you that I never do and never will think of going elsewhere when I can get what I want from Duck."

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The above are only a few of the testimonials we have received concerning our catalog. In this catalog will be found many other equally enthusiastic testimonials on our service and the great values in our wireless and electrical goods.

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Battery Motors
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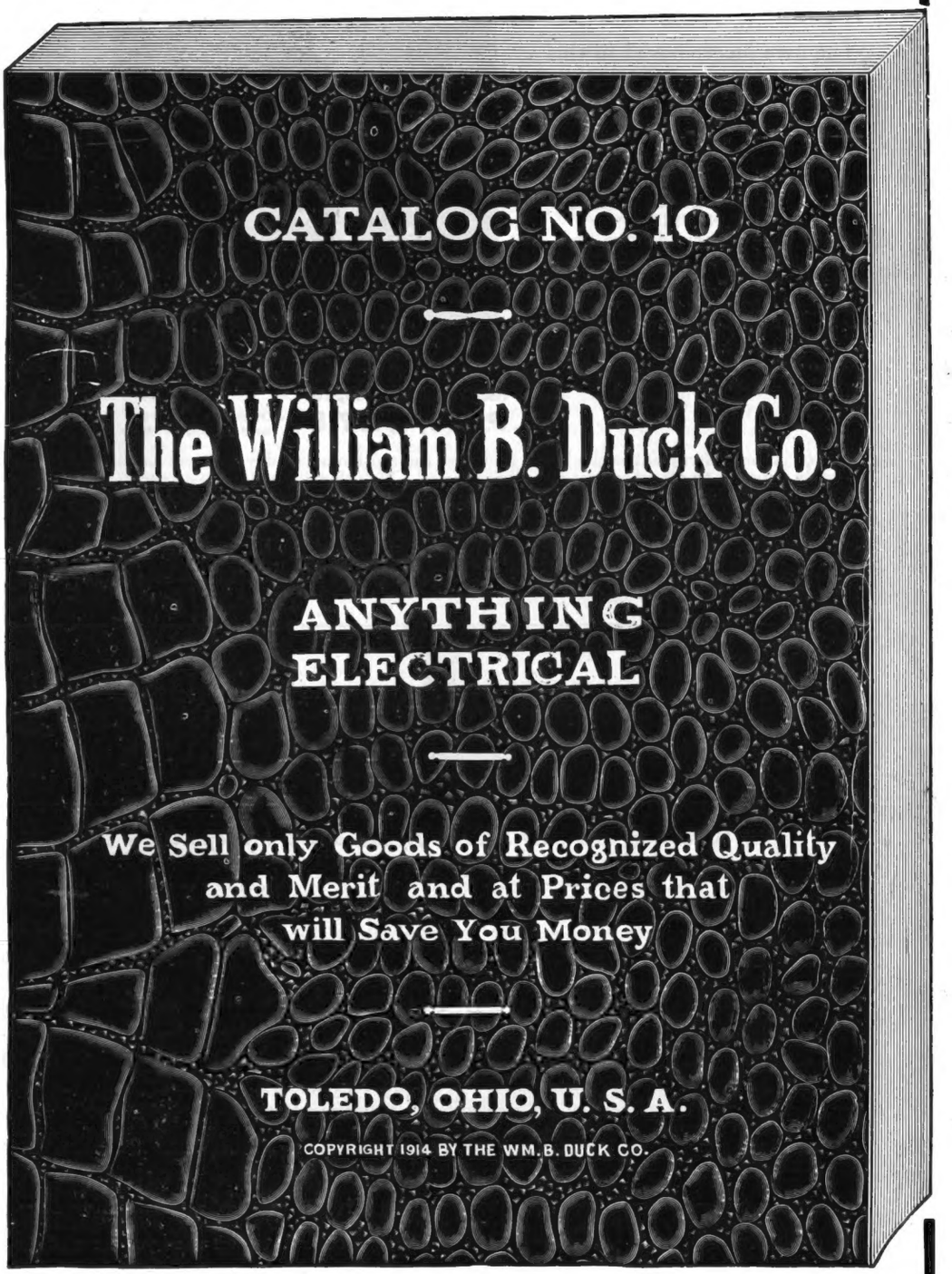
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The William B. Duck Co.
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We Sell only Goods of Recognized Quality and Merit and at Prices that will Save You Money
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The Incomparable
TIGERMAN DETECTO-AMPLIFIER

The Most Sensitive and Serviceable Wireless Receiving Device that has yet been produced

The uses incorporated in this one detector are equivalent to several other complicated and expensive instruments.

SOME OF THE USES

DETECTOR and ONE STEP AMPLIFIER
for receiving damped wave signals and intensifying them from 25 to 50 times.

OSCILLATOR and ONE STEP AMPLIFIER
for receiving undamped wave signals and intensifying them from 25 to 50 times.

Receiving Cabinet Type E

Price, $27.50--Others at Lower and Higher Prices

DETECTOR and OSCILLATOR
for receiving both damped and undamped wave signals.

TWO INDIVIDUAL DETECTORS

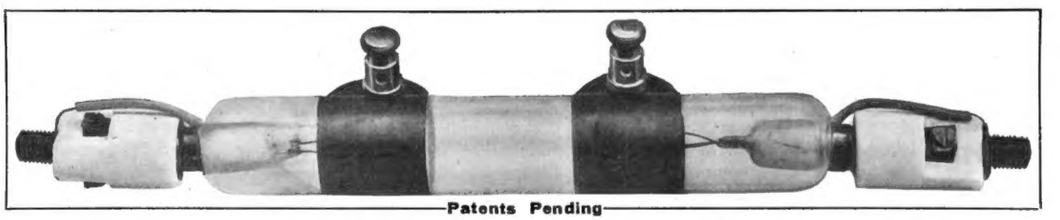
TWO INDIVIDUAL OSCILLATORS

TWO STEP AMPLIFIER

Used in connection with another detector

This receiving instrument is the latest therefore the most modern development in wireless receiving apparatus. It is incomparably superior to all regardless of make or price. No other individual instrument has such a combination of uses as incorporated in the above. It embodies all the advantageous features above enumerated. The amplifying feature makes weak signals from thousands of miles come in roaring with distinct clearness, as they are uninterrupted by static or any atmospheric disturbances.

It is—well, for us to tell you all about this remarkable receiving instrument would require a few pages, and as advertising is quite expensive save us some money by sending for our free descriptive circular which contains all the information. SEND FOR IT RIGHT NOW.



Patents Pending

The following are only a few of the uses incorporated in this one instrument:

Super-Sensitive Detector.—By employing either end of the tube.

Detector and One Step Amplifier.—By employing both ends of tube, using one end as a detector and the other end as an amplifier. This arrangement besides increasing the receiving range to an almost wonderful degree enables the operator to hear weak signals which are impossible of reception without it.

Detector and Oscillator.—By wiring up one end for the reception of damped waves and the opposite end of the tube for undamped waves, rendering your set serviceable for the reception of both mentioned waves by a mere turn of a switch. It can also be used in numerous other hook ups employing the use of two ordinary vacuum detectors.

The Tigerman Detecto-Amplifier is an entirely new invention embodying new features of great importance that are not found in any other vacuum detector, thereby making it unquestionably superior to any in its sensitiveness, efficiency and stability. It infringes on no patent.

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Have you any kind of an old bulb detector? If you have, have you heard of our proposition? Do you know that we will give you, yes, actually give you, one of these remarkable **Tigerman Detecto-Amplifiers** for it and only a small consideration?—Why?—Just to standardize our superior bulb in the wireless field. You are actually losing your hard earned dollars and besides missing all the pleasure it will bring you if you don't grab this proposition. You better act quick because we have it only for a limited time. WRITE AND GET ALL PARTICULARS.

The TIGERMAN DETECTO-AMPLIFIER Is Sold Individually For $7.00
as an introductory price—you will say it is worth twice that much when you learn all about it.

We want representatives in unoccupied territory, write for price list.

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OUR NEW AND LARGER LOCATION
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The Electrical Experimenter

233 Fulton Street, New York.

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A New Radio Law Planned

ELSEWHERE in this issue will be found a draft of the proposed new Radio Law.

As will be noted this journal heartily endorses it, and we believe that all our readers will approve the new measure whole-heartedly.

Inasmuch as this publication is the official organ of the *Radio League of America*, and as it has more Radio Amateur readers than all other technical publications combined, we will probably be criticized severely by certain commercial Wireless interests to whom the new law will be a severe blow.

That these interests will fight the proposed law tooth and nail is a foregone conclusion and that the new law will be past by Congress and that it will be placed on the Statute Books is equally certain.

It will be said that as THE ELECTRICAL EXPERIMENTER serves first and last the Radio Amateurs of this country, it is naturally not concerned in what happens to the commercial interests. This of course is wrong. THE ELECTRICAL EXPERIMENTER is *very* much interested in the commercial phase, for it realizes more than anyone that the Radio Amateurs want to see the Commercial companies live and prosper.

A great many amateurs take up Wireless with a view of entering the service of commercial companies in order to make a living with the experience gained when they were amateurs. So, why should either they or we be antagonistic to the commercial field?

As far as the proposed new law is concerned it will be observed that it leaves things pretty much the same as they are now, both for the commercial companies as well as for the amateurs.

The new phase is found in those sections which will make it unlawful for foreign governments or their agents, or for foreign capital to plant Radio stations on our soil, which stations could violate our neutrality laws, as well as cause serious mischief in case we were at war with another nation or nations.

This was clearly demonstrated to our officials in 1915 when certain commercial stations had to be taken over by our Government because Secretary of the Navy Daniels had conclusive proofs that these stations could be used for transmitting or receiving un-neutral intelligence.

It will also be seen that the new law does not only aim at the foreign commercial Radio interests, but also at alien amateurs as well. In other words, should the proposed law be enacted, no foreigner would be allowed to operate even an amateur radio outfit; the Government would not then issue a license to him.

All this is as it should be and we cannot but heartily endorse the measure. Nor do we think that there is a patriotic Radio Amateur in this country who does not share our view.

This is a country for the people and by the people. We are Americans first, last and always and we shall not knowingly submit to foreign interests playing football with our laws. This is precisely what the new law aims at, and it is for that reason that all patriotic Americans will endorse it.

This country has the most liberal Radio laws of all civilized nations of the world and it grants greater liberty to all Radio interests than any other country. The ether is practically free for all. It should remain free for all—Americans. It should not be free for foreign interests, whose interests are not our own.

As mentioned already, as far as the amateur is concerned, the proposed Radio Law will not change his status whatsoever. He will enjoy substantially the same privileges as at present.

In his letter to Capt. D. W. Todd, publisht elsewhere in this issue, it will be seen that the writer thought it advisable that certain additions be incorporated in the new law. The most important one being that amateurs should not be required to take out a license, if their stations were for receiving purposes only. This suggestion has been made for the reason that the present Radio Law is not specific as to that point. Altho several Government publications mention the fact that receiving stations require no license, the average man does not come to this conclusion by reading thru the Act. This has caused endless correspondence between amateur and Government officials as well as between amateurs and technical journals and Radio Apparatus manufacturers. The uncertainty of not being correctly informed has doubtlessly caused many would-be amateurs from entering the wireless field.

In his Editorial in the February, 1912, issue of *Modern Electrics* the writer recommended that the amateur should be restricted to a wave length of 200 meters and to a transformer input of 1 Kilowatt. This recommendation was incorporated in the Radio Act of 1912 and has proved satisfactory to all concerned. It is to be hoped that the present suggestion will be received equally well.

The Radio Amateurs over 400,000 strong is a unique American institution today. It should remain so.

H. GERNSBACK.

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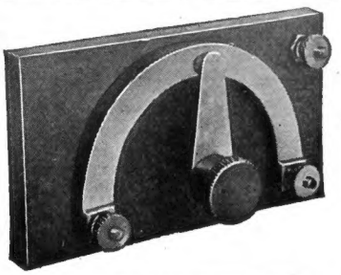

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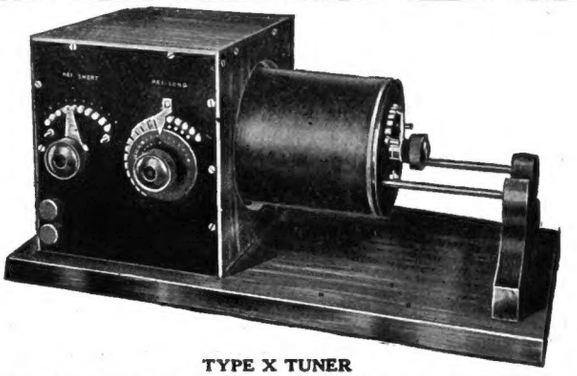

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showing primary dead end switch. A tuner of standard type but embodying a degree of finish and attention to efficiency not usually met with. Solid mahogany with bakelite panel and dead end primary switch.

A NEW RECEIVING SET
of the most modern type. Wound with litzendraht wire to a wave length of 15,000 meters maximum. Primary dead end switch, mahogany case, bakelite panel and exceptional finish and efficiency on all waves.

ROTARY VARIABLE CONDENSER
Our small condensers, either 17 or 43 plates, are a little better value because a little better quality.

ONLY A FEW

instruments selected from our new Catalog X can be shown here. Complete catalogs of Radio Telegraph and Electrical Apparatus, Storage Battery Chargers and parts and supplies will be sent on request and 6c stamps to defray mailing cost.

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141 Main Street Cambridge, Mass.

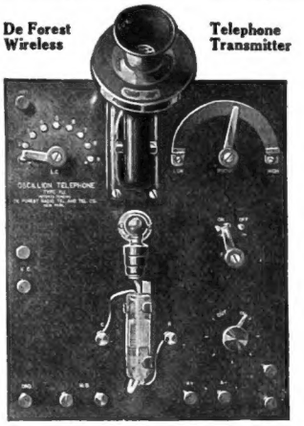
THE BLITZEN WAVE METER
This is a very attractive meter in portable form furnished in several types at a very moderate price.

THE WIRELESS TELEPHONE

Do you realize that a thoroughly practical **Wireless Telephone** simple enough to be used by anyone has been produced?

A GREATER INVENTION THAN WIRELESS TELEGRAPHY

You don't have to be an operator to use the new **De Forest Radio Telephone Transmitter.** Anyone can talk over it the same as over the wire telephone, and the speech is *clear and distinct* and free from all metallic noises.



APPLICATIONS

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 45 JANUARY, 1917 Number 9

The Radio Obliterator

It Spells Death to Radio-Controlled Devices.

WE are all doubtless aware of the wonderful results that John Hays Hammond, Jr., has achieved with his radio-controlled torpedo; in fact, the world has been so amazed by the performance that the United States Government offered him $500,000 for his device, it is said.

However, to an invention of this character there are always two sides. One concerns the merits and advantages of the invention, while the other considers its disadvantages and shortcomings. Insofar as the radio-maneuvered torpedo itself is concerned, this has proved in recent tests to possess, apparently, a marvelous and well-nigh uncanny sense of direction.

Attention is now directed, however, to the real efficiency of the invention when put to active service in time of war, when all the cunning and science of master technicians may be brought to bear on combatting such a demon.

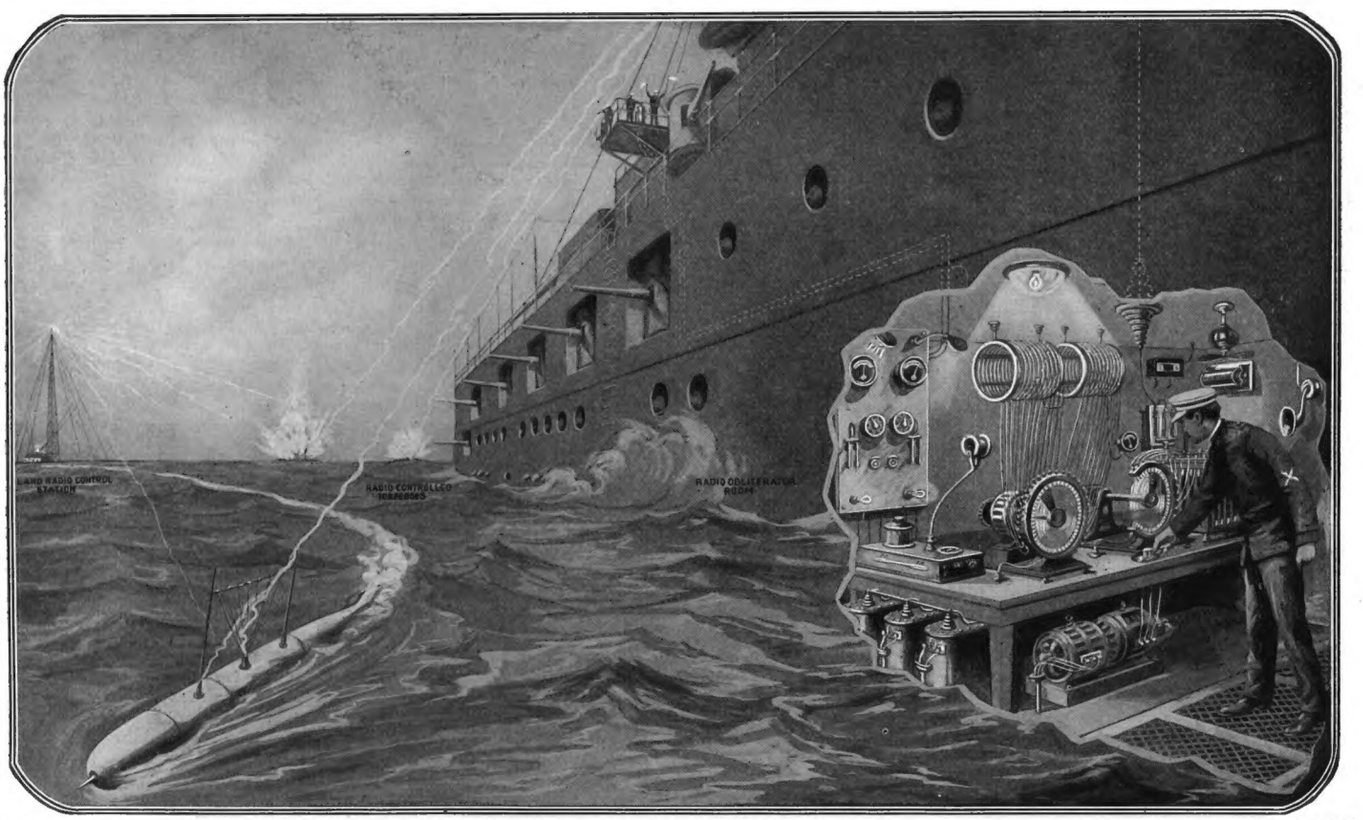
It has been noted as a natural stage in the development of military and naval machines the world over, that as soon as one nation has constructed a new and powerful weapon, then immediately some other nation will exercise every effort to construct a more powerful or combative defensive device. It might be assumed that this is an analagous case.

The Hammond radio-controlled torpedo has yet to meet exhaustive tests of external wireless interference. As an example: Let us suppose that a war-vessel discharges such a radio-controlled torpedo, and assume that the enemy ship has observed the dispatch of this deadly missile. Quite possibly it will know that the torpedo is of the radio maneuvered type and the officer on watch will immediately notify its radio operator, who, knowing his technique, causes his wireless transmitter to radiate a composite wave of many different lengths, thus destroying the effectiveness of the torpedo directed towards his vessel.

It has been learned from an authentic source that the above inventor is employing at present in his radio-controlled device a change in the wave length for controlling his missile, i.e., he employs a sensitive detecting device, tuned by suitable inductances automatically controlled by relays, which inductances control the wave length variations.

Assume, for instance, that the receiver is tuned to 600 meters to operate the explosive charge, 500 meters to start, 800 meters to steer to left, 1000 meters to steer to right and 200 meters to go backwards. These wave lengths are then sent out by the transmitting station on land by merely pressing a certain key, when the impulse of the desired wave length is transmitted and the accurately adjusted receiver will respond to that certain wave length, thus causing the proper mechanism to function, which controls the vessel with perfect ease.

Now if we had a powerful radio transmitter device which would change automatically the emitted wave length from 100 to 10,000 meters, during say one minute, then the radio-controlled affair will be interfered with invariably, as its apparatus will act at every change of wave length, not permitting enough time to cause the con-



The Latest Marvel of Science, the "Radio Obliterator." It Radiates a Perfect Avalanche of Rapidly Changing Wave Lengths, which Spells Failure to All Radio-controlled Torpedoes and Similar Mechanisms, its Inventor Claims.

THOMAS A. EDISON IN HIS LABORATORY.

THOMAS A. EDISON, the well-known electrical inventor, is here pictured at work in his chemical laboratory. So vast has become the researches of this master investigator of electrical and physical subjects, that he has several laboratories in which he may drop at any time for a few hours or possibly a month's work. He is a persistent and indefatigable worker and pursues a particular problem unrelentedly until success seems assured.

Mr. Edison has been honored by many learned institutions and societies the world over and can exhibit when he so chooses, a very formidable array of medals and other symbols of honor.

Many anecdotes have been told about Mr. Edison and his distinct abhorrence to anything at all theatrical or artificial, for to those who know him best he is the soul of modesty.

An amusing incident of his social tendencies in this direction is cited by Frank Dyer and Thomas Commerford Martin, biographers of Mr. Edison.

On one occasion, receiving a medal in New York, Edison forgot it on the ferryboat and left it behind him. A few years ago when Edison had received the Albert medal of the Royal Society of Arts, a visitor at the laboratory asked to see it. Nobody knew where it was; hours past before it could be found; and when at last the accompanying letter was produced, it had an office date-stamp right over the signature of the royal president! A visitor to the laboratory with one of these medallic awards asked Edison if he had any others. "Oh yes," said he, "I have a couple of quarts more up at the house!" All this sounds like lack of appreciation, but is anything else than that. While in Paris, in 1889, he wore the decoration of the Legion of Honor whenever occasion required, but at all other times turned the badge under his lapel, "because he hated to have fellow-Americans think he was showing off." And anyone who knows Edison will bear testimony to his utter absence of ostentation. It may be added, that, in addition to the two quarts of medals up at the house, there will be found many other signal tokens of esteem and good-will—a beautiful cigar-case from the late Czar of Russia, bronzes from the Government of Japan, steel trophies from Krupp, and a host of other mementos, to one of which he thus refers: "When certain experiments with the electric incandescent lamp were going on at Menlo Park, Sarah Bernhardt came to America. One evening, Robert L. Cutting, of New York, brought her out to see the light. She was a terrific 'rubberneck.' She jumped all over the machinery, and I had one man especially to guard her dress. She wanted to know everything. She would speak in French, and Cutting would translate into English. She stayed there about an hour and a half. Bernhardt gave me two pictures, painted by herself, which she sent me from Paris."

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A Recent Photograph of Thomas A. Edison at Work in His Chemical Laboratory.

"After years of watching the processes of nature," he says, "I can no more doubt the existence of an Intelligence that is running things than I do of the existence of myself. Take, for example, the substance water, that forms the crystals known as ice. Now, there are hundreds of combinations that form crystals, and everyone of them, save ice, sinks in water. Ice, I say, doesn't, and it is rather lucky for us mortals, for if it had done so we would all be dead. Why? Simply because if ice sank to the bottoms of the rivers, lakes and oceans as fast as it froze, those places would be frozen up and there would be no water left. That is only one example out of thousands that to me prove beyond the possibility of a doubt that some vast Intelligence is governing this and other planets." Thomas Edison is a true genius and scientist.

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trolling mechanism to properly operate and thereby altering the desired course of the boat or its performance.

It may seem impossible on first impression to build an apparatus for automatically changing the wave length of the transmitter at such a rapid rate as above mentioned, so as to emit different wave lengths and thus produce effective interference. Yet there are people who are working on the subject; notably, Colonel F. P. Cobbam, U.S.A., an engineer of national repute who has spent much time and money in developing his *Radio Obliterator*, an apparatus designed to interfere with any radio-controlled vessel or torpedo which is intended for use in modern warfare.

The U.S. Navy Department is making preparations for a complete test of this device in conjunction with the Hammond radio-controlled torpedo and if the latter will stand the test of Colonel Cobbam's *Radio Obliterator* the Hammond invention will undoubtedly be accepted as a successful and ingenious device.

Very little information can be obtained as to the technical details of Colonel F. P. Cobbam's *Radio Obliterator* just at present. The illustration herewith shows schematically a view of the necessary apparatus. It consists of large helical inductances with numerous leads connected to a rotary switch mounted upon a shaft and revolved by a motor. In front of this inductance a movable contact might be placed so as to press against the convolutions of the inductance, and as the inductance is revolved this contact could be caused to move from left to right and from right to left. As the movable contact moved in or out the inductance effect of the coil would be changed, thus changing the wave length emitted by the transmitter.

On the same shaft or geared to it, as shown, a suitable automatic switching arrangement is connected which changes simultaneously the condenser capacity, which also helps to change the wave length. The exciting apparatus consists of large, high tension transformers, connected in the usual way to the alternating current supplied thru special protecting devices.

Colonel Cobbam's device has been so cleverly designed that the wave length radiated can be changed from 100 meters to 10,000 meters in the space of one second! The time taken to change the wave length can be increased by reducing the speed of the motor driving the inductance and capacity switches. Thus, by merely controlling the speed, the wave length corresponding to that of the torpedo can be ascertained sooner or later which will interfere with the radio-controlled weapon and render its effect nil.

Mr. John Hays Hammond, Jr., claims that no outside radio interference can affect the journey of his vessel or torpedo, and he further states that if a hostile vessel attempts to interfere with his boat that the latter will immediately turn in the direction of the enemy. That sounds bad for the vessel fitted with the new device, if it fails to obliterate—but we shall see.

Mr. Hammond employs, among other things, a time relay for controlling his vessel, thus eliminating most all ordinary radio interference. But the wave length emitted by the Cobbam *Obliterator* can be changed in a fraction of a second to any wave length desired; and at the same time the wave length is automatically changed from a low time value to a very high time value and vice versa, thus a point is sure to be reached, it seems, where the *Radio Obliterator* will strike a wave length and duration of time corresponding exactly to that of the time relay. This causes the desired interference.

We must wait and see the result of the Hammond radio-controlled torpedo when tested with the Cobbam *Radio Obliterator*. A number of the leading radio and electrical engineers of the country have cautioned the U.S. radio experts not to close their tests on any form of radio-actuated device or torpedo until it has absolutely showed that it can withstand the perfect onslaught of wireless waves of every conceivable magnitude hurled at it by the Cobbam machine. The editors have seen these papers and are heartily in accord with the caution note which they sound. There seems a strong probability that we shall presently see a radiodynamic torpedo doubling back on its course and possibly blowing up either itself or its base control plant.

Moonlight on Tap

By Leigh Danen

MOONLIGHT, clear and silvery, is on tap at any time in the Italian garden of James L. Breese, at Southampton, L.I. It can be turned on, by pressing an electric button, any night thruout the year, even rainy ones. Mr. Breese no longer has to depend up on the vagaries of Luna to flood with light his sunken garden, or to add a weird beauty to its wilderness of shrubs and vines and profusion of fountains and statuary.

A new and untried field has been opened up by this wonderfully effective artificial moonlight, that of landscape lighting. While stage, studio, interior and decorative electric illuminating effects have been developed to a high state, this is the first example of permanent, artistic outdoor lighting on a really large scale.

Electric lamps totaling more than *half-a-million candle-power* have been skilfully concealed about the Italian Garden. Numerous sets of dimmers and color screens for them have been worked out; and special glass reflectors coated with pure silver were designed.

While the area covered by this novel system of outdoor illumination is half a mile long, the cost of the experiments including the permanent apparatus has been less than a thousand dollars. By following the methods successfully developed at Southampton, anyone sufficiently interested in this untouched field should be able to try it on a small scale at a very moderate expenditure.

The Italian garden of Mr. Breese is in the shape of a rectangle; the long sides of which measure half a mile and the short sides about a quarter of a mile. The porch of the dwelling marks one of the shorter sides. There is an inner garden, starting at that point and stretching a quarter of a mile, which is bounded by pergolas ten feet high, on its three remaining sides. Close to the house is a playing fountain; the entire garden is bisected by a long walk, and at the far end, is an urn, which indicates the boundary of the estate.

The wonderful tricks, the delicate traceries of light and shadow, the beautiful contrasts which real moonlight brought out in the Italian garden had long been a source of astonishment to the owner's guests; and he decided to attempt to utilize the hidden charm of the garden at all times.

Of course it was impossible for the experimenters actually to imitate moonlight. So, they worked with a view to create an illusion which would suggest it to the beholder, by reproducing a similar diffusion of light by artificial means.

To analyze moonlight and find out its chief element was the first task. Contrary to popular belief moonlight is not blue but a *white* light of low intensity; the bluish tint is the result of the diffusion of the light. If a piece of white paper is held up to moonlight, it will show white with a slight grayish cast. That is because every light is governed by its reflecting surface and the moon being a dead body is gray.

The innovators soon discovered that if they threw a blue light, such as is used to suggest moonlight in a theater upon the vines and shrubbery, their daylight green was merely darkened and very little illumination was secured. This is because foliage absorbs less than 5% of the light which strikes it.

But if a soft white light, with most of the yellow eliminated, was cast on the greens, an illusion of moonlight was obtained, altho highlights and shadows were slightly over-accentuated.

On the pergolas a white light looked crude and stagy, but blue produced the wanted effect; while on the statuary, opalescent lights produced varying, shimmering contrasts.

The next step was to create the desired moonlight illusion in the garden in its entirety. Beautiful effects had been obtained at isolated spots but no harmonious blending results had been secured. To accomplish this powerful electric lamps were placed on the roof of the porch of the house and on top of the pergola.

It was very important to place them high up so as not to impair the vision of spectators, going in the direction from which the light was cast. Those on the porch are thirty feet from the ground; and those on the pergola, ten.

Three lamps casting white lights were set over the porch, one in the middle and one on each side; in each of the adjoining pergolas a blue light was placed; and a white one on top and at the center of the opposite pergola. They are nitrogen filled bulbs, each of 67,000 candle-power, giving a total illumination force of 402,000 candle-power.

The center lamp floods the long walk which runs through the center of the inner garden; and the lamp on the opposite pergola takes up the illumination at that point, bathing with a soft light the remainder of the walk, as far as it goes.

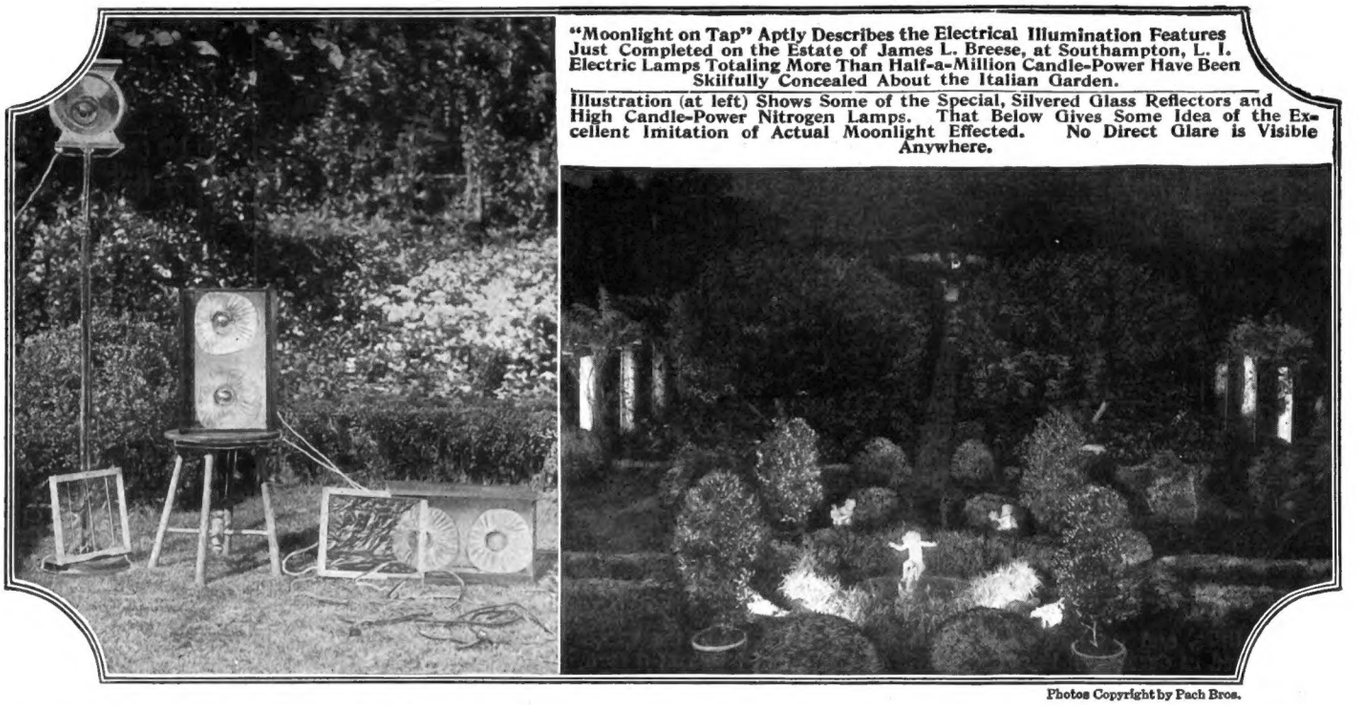
The lamps on both sides of it also are focused on the inner garden and are pitched at a downward angle to cover all the foliage, while those at the entrance to the pergolas throw blue horizontal rays across the marble pillars and walks. All of the lights are adroitly masked from view behind masses of foliage and greens.

On two sides of the playing fountain near the house are batteries of lights, each of two lamps. And at the urn at the far end of the long walk is a similar battery of lights. They also are nitrogen filled bulbs, each of 25,000 candle-power—a total of 150,000 candle-power.

By means of dimmers and color screens, these lights are made slowly and subtly to change colors, which vary all the way from green, pink and amber to purple and blue. Thus warm, delicate colors are turned on the statuary, greatly enhancing their beauty.

For some time, the experimenters had great difficulty in finding a suitable and serviceable reflector. Ordinary mirrors coated with mercury were tried, but the heat generated by the lamps heated the mercury to such a degree that it evaporated; also, the glass of the reflector melted and once the bulb itself became so

(*Continued on page 671*)



"Moonlight on Tap" Aptly Describes the Electrical Illumination Features Just Completed on the Estate of James L. Breese, at Southampton, L. I. Electric Lamps Totaling More Than Half-a-Million Candle-Power Have Been Skilfully Concealed About the Italian Garden.

Illustration (at left) Shows Some of the Special, Silvered Glass Reflectors and High Candle-Power Nitrogen Lamps. That Below Gives Some Idea of the Excellent Imitation of Actual Moonlight Effected. No Direct Glare is Visible Anywhere.

Photos Copyright by Pach Bros.

How Electricity Helps to Mine and Purify Gold

GOLD! The magic word that has charmed mankind since prehistoric ages. Even when it was not used as a means of payment for man's debts, it was revered by all from the priest to the peasant for its wonderful qualities, and we find evidence of its being used in decorating the finest palaces and public buildings of ancient times.

To-day, the average person handles but very little gold, and this is mostly in the form of jewelry. Gold coin, at least in America, is seen but seldom, especially in the Eastern states, altho there is a very large quantity of it in use for the payment of banking transactions, etc.

Electricity helps enormously, and in many cases proves invaluable, in the many diversified operations attending the mining, transportation and refining of gold. The accompanying illustrations are unusually interesting as they show actual views of gold producing and refining operations.

It is indeed surprising to learn that the spirit of electricity has permeated the freezing cold of the Klondike gold country.

This brings to mind one of the new wonders of civil engineering in the far north where "Jack Frost" is king. It is the invention of Joe Boyle, by which he keeps his big hydro-electric plant at Boyle Creek, Klondike, running right thru the winter, and that notwithstanding the temperature at times falls to 70 degrees below zero! It is so cold there in the winter that if you should attempt to run a spraying machine such as is used in an orchard the water would turn to snow before it fell to the ground. The thermometer keeps down to zero, or far below that, for the most of the winter, and after the cold weather sets in the land is ice-locked until spring. Some of the streams have seven feet of ice over them, and many freeze solid. Nevertheless, Mr. Boyle has been able to turn a branch of the Klondike River into a great ditch six miles in length and drop it down upon turbines with a fall that creates electricity to the extent of 10,000 horsepower—day in, day out, the year thru. The amount he is actually using is only 3,000 horsepower, but the equipment is such that it could be easily increased by the addition of more units.

There are many electric plants of this kind in the world, but none which are moved by water having such temperatures as freeze the soil and gravel everywhere to a depth of seven feet, or where the river runs above strata of perpetual ice. How did Joe Boyle solve the problem? He did it by marrying the common horse sense for which he is noted to his genius for practical invention. He knew that the waters of the Yukon and the Klondike flow under the ice all winter long and that there is a space between the water and the ice overhead.

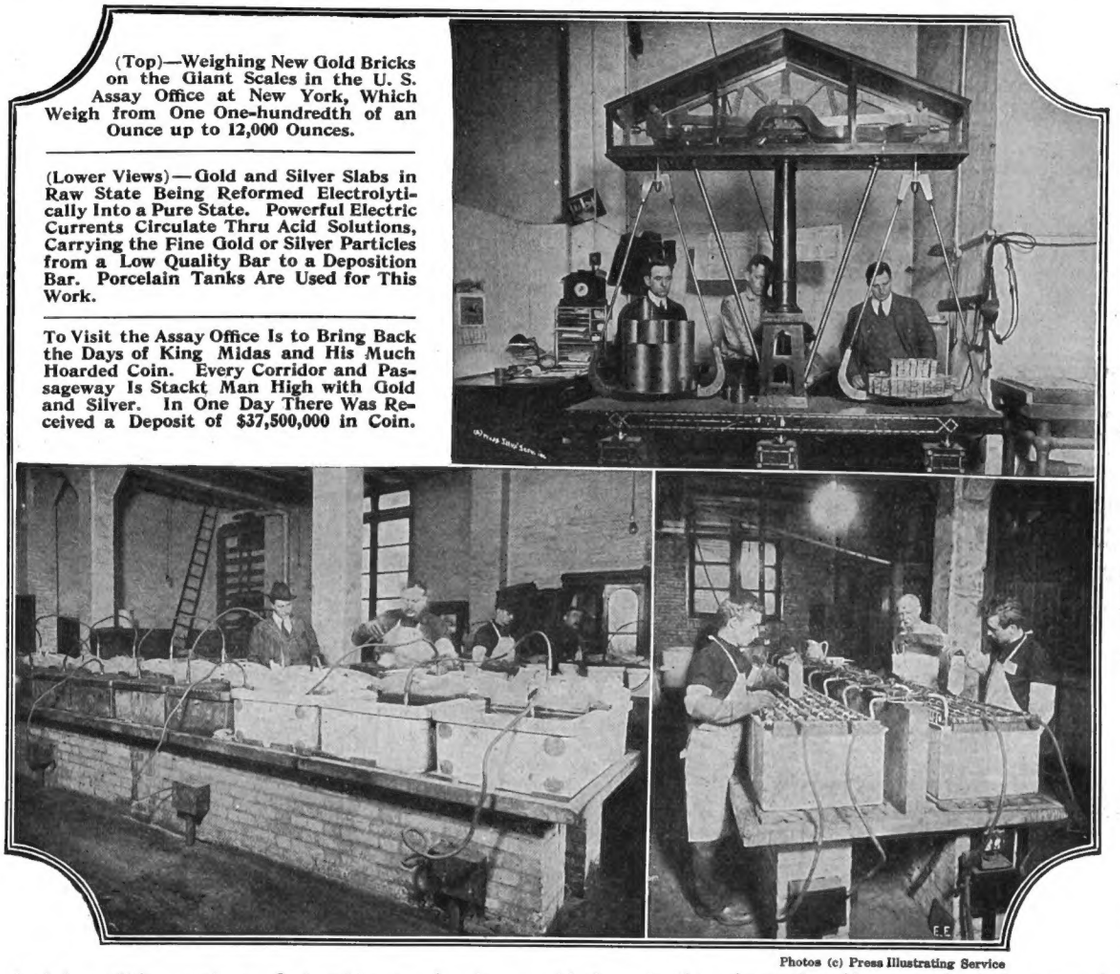
He concluded that it was this dead-air space that kept the running water from freezing. He fills his ditch to the top and allows nature to freeze a sheet of ice a foot or so thick upon it. He then drops the water for a depth of two feet and has still a running stream of four feet or more farther down. The dead-air space above keeps off most of the frost, and in order to add to the heat, he installs *electric heaters in the bed of the stream,* which aid in keeping the water from freezing (see illustration). These heaters each represent units equaling about 100 horsepower. There are comparatively few of them in the six miles of ditch. They do

(*Continued on page 687*)

(Top)—Weighing New Gold Bricks on the Giant Scales in the U. S. Assay Office at New York, Which Weigh from One One-hundredth of an Ounce up to 12,000 Ounces.

(Lower Views)—Gold and Silver Slabs in Raw State Being Reformed Electrolytically Into a Pure State. Powerful Electric Currents Circulate Thru Acid Solutions, Carrying the Fine Gold or Silver Particles from a Low Quality Bar to a Deposition Bar. Porcelain Tanks Are Used for This Work.

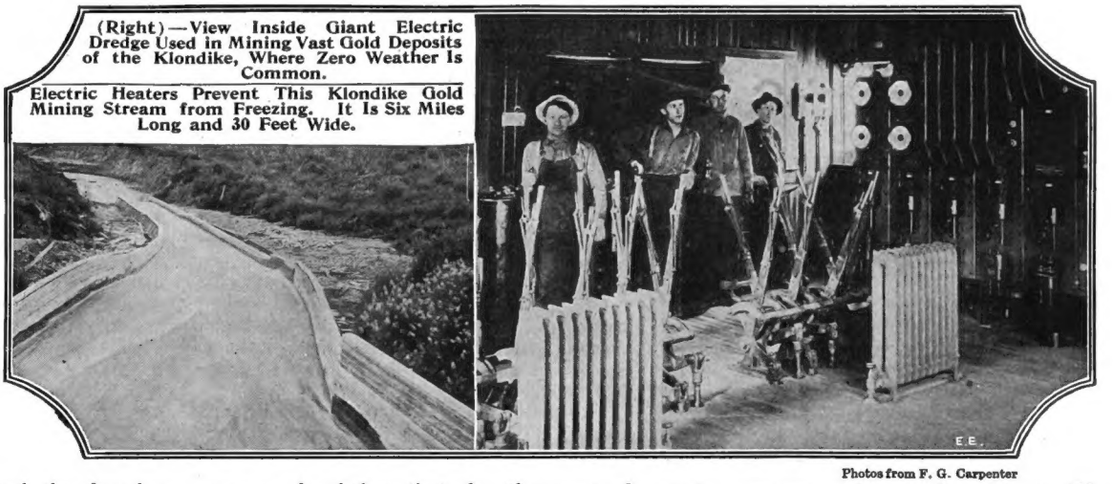
To Visit the Assay Office Is to Bring Back the Days of King Midas and His Much Hoarded Coin. Every Corridor and Passageway Is Stackt Man High with Gold and Silver. In One Day There Was Received a Deposit of $37,500,000 in Coin.



Photos (c) Press Illustrating Service

(Right)—View Inside Giant Electric Dredge Used in Mining Vast Gold Deposits of the Klondike, Where Zero Weather Is Common.

Electric Heaters Prevent This Klondike Gold Mining Stream from Freezing. It Is Six Miles Long and 30 Feet Wide.



Photos from F. G. Carpenter

A Complete Portable X-Ray Plant Used by European Armies

WHEN the English, French or Russian soldier is put out of commission by a sharp-nosed German bullet or a shrapnel splinter, he has one thing to be thankful for in most instances. That is a well organized and equipped hospital corps who, by means of their highly efficient X-ray outfits, can locate most anything in any part of the human body. You are on the firing line banging away with your magazine rifle at the skull of a German officer when zing—you feel faint and drop in your tracks. The light of day fades away and when you at last gain consciousness it is to find yourself strapped to a massive table fitted with a score of handles, rods, and what not. It is the X-ray room of H.M. Medical Corps, a short distance back of the second line trench. They found it—a bullet that just missed your heart. Such an experience occurs hundreds of times daily on European battlefields.

Here we have a photo of one of the finest portable X-ray outfits supplied the British and other allied forces for field operations. These wonderful outfits are veritable traveling hospitals.

The complete dynamo generating set, which is exceedingly compact, occupying a space of only 3 feet by 2 feet by 3 feet, comprises a single-cylinder gasoline engine developing 1.5 horsepower at a speed of 1,300 r.p.m., radiator, muffler, gasoline tank, dynamo and switch box. The whole is enclosed in a wooden box provided with carrying handles and also with a receptacle for the necessary tools.

One of the Magnificent Portable X-Ray Outfits in Use by the Allies on the Battle-field. It Includes a High Power X-Ray Tube and Coil which Receives Current from a Special Dynamo Driven by the Gasoline Engine.

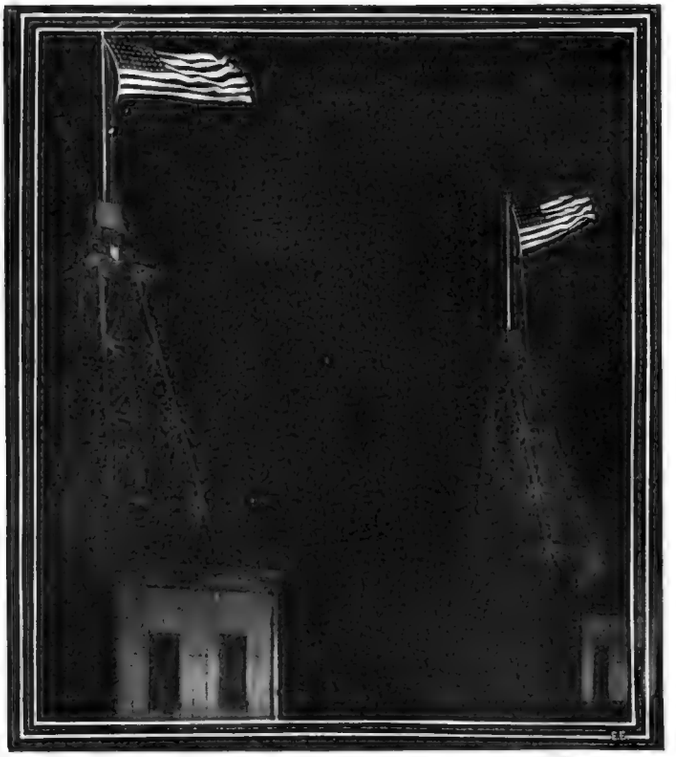
The dynamo or generator is mounted at the side of the engine on an extension of the crank case. It is of the reverse compound-wound type, having an output of 10 amp. at 70 volts, and is directly driven by the engine. The latter is put in operation by means of a pulley on the rear end of the dynamo spindle, the necessary initial impetus being given by a strap working on the pulley. In order that the engine shall run at a constant speed, it is fitted with a centrifugal governor, which acts on the throttle valve in the carburetor.

The switch gear, which is entirely enclosed in an aluminum case mounted above the dynamo, is of the rotary type and furnished with outside operating handles. It is arranged to give any of the following combinations: (1) Off position, (2) battery to X-ray coil, (3) battery charging and dynamo and battery in parallel to X-ray coil, (4) dynamo and X-ray coil only, (5) battery and dynamo in series to X-ray coil. The voltages to the coil are approximately: No. 2 position, 36 volts; No. 3 position, 36 volts to 45 volts; No. 4 position, 75 volts, and No. 5 position, 110 volts.

The X-ray bulb supplied is sufficiently large to permit of taking radiographs through the thicker portions of the body. This X-ray outfit complete on its chassis was built by the Austin Motor Company, Ltd., of Birmingham, England, to whom we are indebted for the photograph here reproduced.

ILLUMINATED FLAGS ECONOMICAL ADVERTISEMENT.

Illuminating the flag that ordinarily flies at the masthead during the daytime is one of the latest and happily a very economical method of advertising your factory, office or other place of business.



One of the Latest Advertising and Decorative Schemes Is to Illuminate Your Flag at Night. The New "Flood Lighting" Is Utilized in the Present Instance with Highly Effective and Economical Results.

Two flags on the generating station of the United Electric Light & Power Company, New York City, are flood-lighted nightly and can be seen for several miles in each direction. Each flag is 15 feet long and is illuminated by three 500-watt, Type C, concentrated filament tungsten lamps, mounted in reflectors 120 feet distant from the flag. Three reflectors are placed directly in front of each flag, two serving to illuminate the flag immediately in front, while the beam from the third lamp is turned across onto the other flag. The flags are lighted at sunset and remain illuminated until midnight. Hundreds of people see these flags each night, and the favorable comments that have been received from civic and patriotic organizations indicate the large amount of interest shown by the public.

Many hotels in the large cities find this a novel and efficient means of attracting attention to their hostelry. One of the largest hotels in New York City utilizes a small electric searchlight, the beam of which creates a very mystical effect, as it lights up the American as well as the hotel flag. A white flag for the latter shows up best, with the hotel name spread across it in black letters.

THE PARIS TELEPHONE SYSTEM.

An appropriation of $24,000,000 has been asked of the French Parliament for improvements and extension of the telephone system in Paris. Six large new exchanges will be established. The three existing exchanges will be enlarged and new multiple switchboards for 12,600 lines installed. Long distance underground lines will also be laid.

There are nearly a thousand electric ranges in use in the city of Winnipeg, Can.

Illuminated American Flag Protects Ocean Travelers

THOSE who have had to travel across the Atlantic Ocean during the past year or two have experienced many sleepless nights when the least sound caused them to think invariably of a submarine attack.

The photograph here reproduced of the Hawaiian-American liner *Kansan* was taken upon her arrival at Boston, after having been held up by the German submarine "U-56." The *Kansan* was the first ship stopt by the German under-sea raiders. She was en route from New York to Boston and thence to Europe under charter to the French Government.

Photo Copyright by International Film Service.

The Photo Shows the Hawaiian-American Liner "Kansan" Upon Her Arrival at Boston, After Having Been Held Up by the German Submarine "U-56." The American Flag Painted on the Hull Is Illuminated at Night by Powerful Electric Lights.

The accompanying photograph, as well as our front cover illustration, show graphically how the American Flag on the Hawaiian-American steamship *Kansan* has been advantageously used for the protection of neutral ocean travelers.

As seen the replica of the United States flag in this case is painted on either side of the steamship and powerful electric lamps and reflectors are suitably arranged so as to cast their rays on the painted flag at night.

All thru the darkest nights the steamship is thus protected from untoward attacks by surreptitious U-boat commanders. As will be remembered, there are a number of instances on record where harmless vessels have been fired upon and even sent to a watery grave by belligerent submarines, and the after plea has, in a number of instances, been that those on board the submarine craft were afraid to venture very close to the unknown steamship for fear of being fired upon; and also, the argument has been raised a number of times by the attacking submarine officers, that they could get no reply in any way to their wireless or megaphone queries.

However, this scheme, utilizing the immense painted flag on the hull of the vessel, illuminated at night, would seem to be a very sure manner of indicating to any submarine commander as to just what ship he was dealing with. This idea has been effectively employed by several other neutral powers for the protection of their merchant marine craft and very little trouble has ensued since the adoption of this plan.

The flag painted on the side of the ship is not only effective at night, but also in the day time, and if the various countries would follow the principles of international law and refrain from making improper use of this effective insignia, it would seem a very practical and sure means of saving many lives.

STORAGE BATTERIES IN MODERN SUBMARINES.

The present illustration shows the large storage battery installation on one of the latest submarine fighters—the *Isaac Peral* of the Spanish Navy. This vessel was built in the United States and represents one of the very latest ideas in submarine boat engineering. The precautions taken to carry off all the gases generated when the batteries are working is apparent from the size of the large vent pipes in the photograph. Each battery cell has a small size vent pipe leading off into a large central tube.

The *Isaac Peral* is the latest and most modern submarine built for the Spanish Navy by an American concern. The photograph was taken during the trial trips off Provincetown. The undersea boat can submerge in one minute and come to the surface in one minute and a half. It can submerge to a depth of 400 feet, altho the guarantee only calls for 200 feet.

The boat has two periscopes. It is electrically steered; when traveling on the surface the navigator works from the bridge, and while traveling submerged, he can either operate from the conning tower or from below. The submarine has a cruising radius of 8,000 miles and can easily cross the Atlantic and back again without refueling. It carries a crew of twenty-two men and two officers. While making a submerging test, it was demonstrated by the amount of air used, that if necessary, the crew of twenty-four men can live in the submarine submerged for forty-five hours. According to eye-witness descriptions, the now famous *Deutschland* and *U-56* are almost exact duplicates of the *Isaac Peral.*

The switchboards installed in the submarines for controlling the charging current of the storage batteries and the transposition of the dynamo-motor connections are very elaborate altho marvelously compact ones, and to visiting "land-lubbers" prove a most interesting and startling innovation in switchboard design.

The storage batteries are charged when the sub-sea fighter travels on the surface of the waves, the oil engines driving the dynamo-electric machines so as to cause them to generate sufficient current for charging purposes. As soon as the vessel dives, the engines are cut out and battery current is switched on the dynamos, which now operate as motors for driving the propellers.

Photo Copyright by International Film Service.

What the Interior of a Recently Built Submarine Battery Room Looks Like. Note the Vent Pipes "V" Designed to Carry Off the Dangerous Gases from the Battery.

How Electricity Produces Mystery in the Movies

Electricity is playing a very important rôle in the moving picture art. So much so, that without the use of this mystifying agent, it would be difficult, if not quite impossible, to stage our modern scientific moving pictures, which show so realistically such wonderful thunder storms, radio controlled torpedoes, mind-reading machines, and hundreds of other possible and impossible creations of the human brain.

Spat! Spat! Sings the Mighty Spark of the Wireless in This Latest "Battle Scene" from the Exciting Film Play, "Liberty." Yes, It Looks Like the Real Thing.

Many of us have had the pleasure of witnessing the spectacular photo play "The Black Box" in which the most wonderful electrical displays were exhibited. The illustration shows one of the detectives, in this absorbing screen story, making a test in his laboratory, also his two female assistants. This room is elaborately equipt with a startling galaxy of electrical instruments and two high-frequency machines, one of which is a large Wimshurst static machine, seen at the left. A mammoth Tesla high-frequency transformer appears in the background. The high tension current supplied to the primary of this coil is obtained from a large alternating current, step-up transformer, and is past thru a rotary spark gap. The leads from the half-million volt Tesla coil are connected to various different apparatus stationed about the laboratory.

One that may be particularly noted is the rectangular screen. This consists of a long copper wire wound between two glass rods and when properly excited by the Tesla transformer it produces one of the most spectacular effects imaginable. A powerful discharge appears on the various sections of the wire and the whole effect seems as if the entire instrument is enveloped in flames. Two large Leyden jars are used for the condensers, one of which is seen to the right of the door.

Radio apparatus has again been featured in one of the latest serial photo-plays entitled "Liberty," produced by the Universal Film Company. This scene shows one of the duly uniformed Army Officers receiving an important message *via radio* from one of the commanding officers on the firing line. The large armored motor car seen in the immediate back-ground whirls away at terrific speed as soon as the word is received by the radio operator.

FOR THE WOMAN WHO COOKS BY ELECTRICITY.

The woman who cooks with an electric range for the first time should be given careful instruction in its use, for the arts of cooking by electricity and cooking with coal differ widely. An electric-range manufacturer offers the following excellent suggestions for conserving the consumption of electricity which apply to almost any type of electric range.

In boiling operations, bring liquids to boil on *full* heat. Then switch to *low*. This cuts down the current consumption by three-quarters—an immense saving. *Low* heat will keep the water boiling.

Do not allow liquids to bubble-boil. This is entirely unnecessary. By so doing you are merely turning the water of the liquid into steam, where it is wasted. No matter how much current is applied, the liquid cannot be made hotter than the boiling point.

Many housewives believe that the food is not cooking unless the water is bubbling furiously. This is a mistake. If the water is steaming it is hot enough to do the work, and current is saved.

Turn current entirely off about ten minutes before thru boiling. The heat stored in the unit will keep the liquid at the boiling temperature for the remainder of the cooking operation.

Use flat-bottomed utensils, preferably those made of steel or aluminum. These are to be preferred to poreclain ware, for they conduct the heat better.

Do not use too much water. This is extremely important. It requires a lot of electricity to heat the extra water and this heat is usually wasted.

In cooking vegetables, these need not be submerged in the water. The steam will do the cooking. For instance—in boiling eggs—use only enough water to cover the bottom of the vessel—generally about half a cupful. This amount of water is quickly boiled and the steam does the cooking.

The same principle applies to any boiling operation. Put a cupful of water on potatoes and watch the result.

Boiling is the most expensive operation performed on the electric stove, and the above instructions, carefully followed out, will cause a material saving in your bill for electricity.

Do not heat a gallon of water if you need only a pint.

The oven is the most economical part of the stove if properly used.

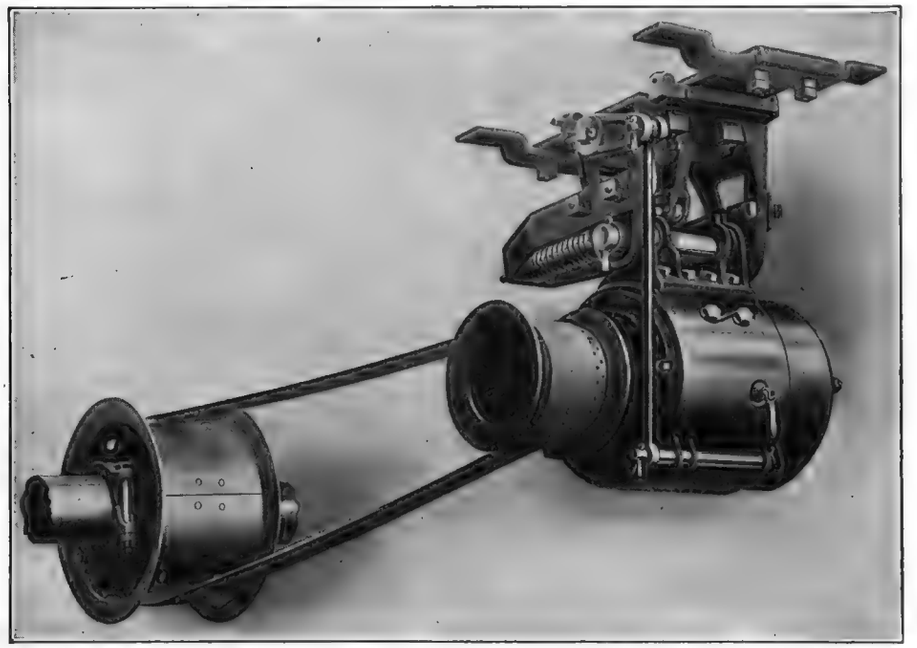
Do not use water in roasting, as it is entirely unnecessary. The electric oven is an air-tight fireless cooker, and the natural moisture of the meat is not evaporated, but is retained.

When placing a roast in your oven, see that the indicator registers the proper temperature. After the roast has been in for about ten minutes, turn the current off. Do not open the door, but permit all the heat to remain inside the oven. Allow 15 minutes to the pound for cooking.

One of the Best Electrical Laboratory Scenes Ever Produced—A Moment from the Screen Play, "The Black Box."

How Railroad Trains Electric Light Themselves

WHEN you ride in an up-to-date railroad train at night you invariably notice the electric illumination. Once—in our grandfather's day—it was produced by the evil-smelling oil lamp. Then we had, and still do have to some extent, the gas lamp supplied by a high pressure gas tank supported under the coach. But today we find all the best railroad passenger coaches equipt with electric lights. Possibly you never stopt to philosophize regarding this every-day convenience.



As You Speed Along in a Railroad Car One of These Busy Little Dynamos, Belted to the Car Axle, Is Pumping Electricity Into the Lamp Circuit and Into a Storage Battery for Stand-still Lighting Later.

Let us consider then the three known general methods of securing electric light on railroad cars. First, there is the straight storage system, in which a car carries a very large battery so as to receive at the terminal charging station a sufficient charge of electrical energy to last to the next charging station. This means hauling excessive weight and switching of cars onto charging tracks and holding them there for the hours of charging which each trip demands. This system interferes either with normal car movements or with proper charging of the batteries or with both. The exigencies of railroad operation are such that one can hardly count on proper charging under such conditions. It takes just so many hours to charge a battery right. To force the charge inevitably damages the battery and such damage is hardly avoidable with the straight storage system.

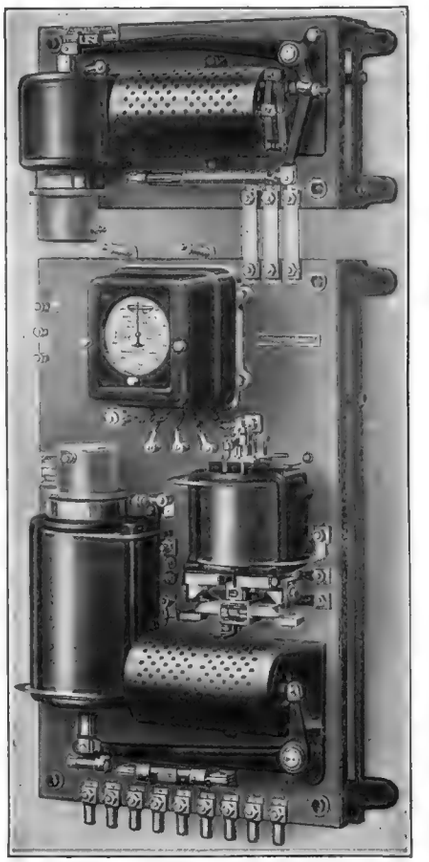
Then there is the head end system with a special electric generating equipment on board the train supplying the lighting energy for the cars trailing behind. There are several objections to this system such that it has but few installations.

Against both of the foregoing systems the axle-driven unit system in which the dynamo is driven from the car axle by a belt has steadily gained favor in the past few years, because it has gradually attained to the operating perfection of an up-to-date stationary electric plant.

The axle-driven unit system makes each car an independent unit, which goes about its own business, charges its own battery *en route* and is in every way sufficient unto itself. The operating department handles cars and trains oblivious of lighting problems—it has but to couple the cars and air hose. There is no special switching of cars, no interference, and no delay.

The improved axle car lighting system here illustrated charges its battery perfectly—attaining a result hardly to be hoped for in the terminal charging scheme. Furthermore, the generator does all the work, that is, carries whatever lamp or fan load may exist, all the time that the car runs at generating speed. During this generating time the battery rides as a passenger, does no work, and receives automatically, in an ideal manner only such charging as it requires. The principle involved in this particular design utilizes the axle energy every moment it is available and works the battery only when such energy is not available. For this reason the axle drive system can accomplish its ends with a battery of the lowest capacity and therefore of the smallest weight and cost practicable.

The illustrations herewith show how the enclosed dynamo is mounted under the train and belt driven from split steel pulley clamped on the main axle. Note the holes in the dynamo pulley—these help to make the belt drive more steadily, as otherwise there are apt to be air pockets formed between the moving belt and the pulley face. The feed wires from the dynamo lead to the automatic switch-control panel here shown. This contains the necessary cut-off relay to open the dynamo circuit when its speed, and consequently its voltage, falls below a certain value. There are also provided automatic voltage regulators for the various circuits so that the lamps and the storage battery will receive the proper potential while an ampere-hour meter indicates directly the state of charge in the battery in ampere-hours.



The Simple, Yet Exact Automatic Switchboard which Cares for the Dynamo and Storage Battery Currents, Besides Regulating the Voltage Supplied to the Car Lamps. It Even Indicates the Ampere Hours Left in the Battery.

COBWEBS TROUBLESOME ON ARGENTINE TELEGRAPH LINES.

Mr. J. W. Stubbs, superintending telegraph engineer, Buenos Aires and Pacific Railway, Argentina, says that telegraph and telephone wires in the Argentine Republic are at certain seasons of the year subject to a partial or almost entire interruption, owing to the prevalence of spiders' webs (known colloquially as Devil's Beard), which covers the wires for a distance of many miles, and which, as soon as the sun sets, become saturated with moisture, causing contacts between the various conductors.

The webs themselves are like gossamer threads, but are in such abundance that as much as eleven pounds in weight have been swept from a line of four wires over a distance of six and a quarter miles. When swept together the webs have the appearance of a kind of gray cotton waste, which will not flame up when lighted but smoulders for a considerable time.

The trouble is so serious that the Argentine government addrest a circular to the different telegraph administrations all over the world to ascertain if anything similar was experienced elsewhere, and, if so, the means taken to counteract it. The replies received showed that in no country outside South America was anything of a like nature met with.

WOMAN TAXI DRIVER OPERATES ELECTRIC.

Boston has one woman chauffeur, and only one. She drives a taxicab, an electric machine, and is making a success of her undertaking. The young woman is Miss Florence Mayo, and her stand is on Newberry Street, in the fashionable Back Bay district. Miss Mayo undertook the work partly on account of failing health. She conceived the idea of running a gasoline taxi, but found there were no facilities for learning to operate. Consequently, she turned to the electric machines. It took only a few hours to learn the mechanism. Recently Miss Mayo carried a patient who was very ill to the hospital, his physician not daring to risk a gasoline car.

RADIO MESSAGES PASS BETWEEN JAPAN AND U.S.

Trans-Pacific wireless service between the United States and Japan was established on November fifteenth by the Marconi Wireless Telegraph Company. The inauguration of the service was marked by the exchange of messages between the two countries.

President Wilson sent this greeting to the Emperor of Japan:

"The Government and people of the United States of America send greetings to your Imperial Majesty and to the people of Japan, and rejoice in this triumph of science which enables the voice of America from the Far West to cross the silent spaces of the world and speak to Japan in the Far East, hailing the dawn of a new day.

"May this wonderful event confirm the unbroken friendship of our two nations and give assurance of a never-ending interchange of messages of good will. May the day soon come when the voice of peace, carried by these silent messengers, shall go into all the world and its words to the end of the world."

The message was sent from the station of the Marconi Company at Bolinas, Cal., to its receiving station at Kahuku, Hawaii, and instantaneously retransmitted by automatic relay to Funabashi, Japan, station of the Japanese Government.

Emperor Yoshihito of Japan replied by wireless to the message of President Wilson as follows:—

"It affords me much pleasure that the first use of the installation of wireless telegraphy between Japan and the United States has been to transmit your cordial message. In return I send this expression of my thanks for the good wishes exhibited toward me and my people, and of the hearty desire entertained thruout Japan for the continued prosperity and welfare of the United States."

Wireless communication between the United States and Hawaii was put in operation September 24, 1914.

The establishment of wireless communication with Japan creates a new and important chapter in the wonderful scientific records of the Nineteenth and Twentieth Centuries. It will largely increase good business and friendly feeling between the two countries. Now that the service has been extended to Japan, connection will be made with the Japanese Imperial Telegraph system to all points in the Orient.

For the present the service will be confined to San Francisco, Hawaii and Japan. There will be two classes of service between San Francisco and Japan, a full rate or expedited service at 80 cents per word, a reduction of 41 cents per word from the existing cable rates, and a deferred half-rate service at 40 cents per word, the lowest cable rate at present being $1.21 per word.

In the first hour in which the service was put in operation fifty-two messages of congratulation were received and transmitted. Among these was an exchange of greetings between the Japanese Ambassador to this country and the American Ambassador to Japan. Guglielmo Marconi and Godfrey Isaacs sent their congratulations to Jiro Tanaka, Director of Posts and Telegraphs of Japan.

IN THE FEBRUARY "E. E."

Nikola Tesla, His Life and Inventions—Some things you don't know about this great genius. Wonderfully illustrated with a supplement of Mr. Tesla suitable for framing. By Samuel Cohen.

Electric Power from Ocean Waves—A scheme to utilize in a new way the inexhaustible energy inherent in the ever-rolling waves of the sea. By H. Winfield Secor.

Baron Münchhausen in a New Martian Adventure. By Hugo Gernsback.

Experimental Physics—Start of a new and intensely interesting series. By John J. Furia, A.B., M.A., F.K.S.

Testing Ultra-high Voltages with Spark Gaps—With complete details and tables.

Bakelite—The New Insulation. How it is made and its properties.

Construction of a Practical 6 Volt, 25 Ampere-hour Storage Battery. By B. Francis Dashiell, M.E.

Celluloid Jars for Storage Batteries and How to Make Them Cheaply.

A New Circuit for Undamped Wave Signal Reception, Including Loose Coupler Details. By Dr. G. M. Christine.

The How and Why of Radio Apparatus. Part 3—High Tension Condensers, How to Design and Build Them.

The Design of Large Radio Receiving Transformers—A Mathematical treatment of this all-important subject with curves and tables worked out, for wave lengths up to 10,000 meters and above. By Charles S. Ballantine.

The Kilbourne and Clark Wireless System—Something new.

MYSTERIOUS ELECTRIC WEIGHT "HEFTY" BUT NOT HEAVY.

The day of the famous or rather infamous *goat*, which all new lodge and fraternity candidates are supposed to ride before they are accepted as full-fledged members, is being daily electrified in several ways.

Some time ago there was an electric "initiation" chair described in the columns of THE ELECTRICAL EXPERIMENTER, arranged with a small shocking coil, battery and sensitive spring contact in the seat, so that when the newly elected candidate sat on it he would receive the surprise of his life, and not in the form of a glad hand, either!

The present illustration shows a newly conceived, electrified weight devised by Mr. John J. Odenwald, for use in initiating new members of secret fraternities and similar organizations.

Within a bogus weight, marked conspicuously 200 pounds, as shown, but with an actual weight of less than 40 pounds, there is placed the necessary electric shocking paraphernalia, comprising a small induction or shocking coil, a couple of dry cells and an automatic switch which is closed as soon as the victim, in his effort to lift the weight, exerts an upward pressure on the handles at the top. The amusement caused by the consternation of the person trying to lift the weight may be easily imagined

A "Bogus" Weight Which, When Lifted, Gives the Would-be Samson the Surprise of His Life in the Form of an Electric Shock.

and also the gullibility with which he will seize the opportunity of showing his marvelous physique. It goes without saying that he won't hold on to it for many seconds.

ELECTRIC LAMP HELMET FOR ENGLISH POLICE.

The accompanying illustration shows one of the latest European novelties in the form of an electric flash lamp bulb attached to the spike of the helmet, as worn by the policemen of Birmingham, England.

English Policemen Now Carry a Miniature Electric Signaling Lamp on Their Helmets. Highly Effective During "Zep" Raids When Streets Are Darkened.

The light is supplied with current from a small battery carried on the belt and the communicating wire between the lamp and battery is plainly visible in the photograph. The lamp can be switched on and off rapidly for signaling purposes, particularly when streets are pitchblack, as during a Zeppelin raid, and would also appear to provide a very satisfactory method of communicating with other policemen in the event of riots, street fights, etc.

It has perhaps been noticed that in many a street brawl the officer of the law does not always have the upper hand, by any means, and it frequently happens that the policeman finds it extremely difficult, if not impossible, to rap on the pavement with his trusty club or to blow his whistle the required three blasts.

It would be readily possible to arrange such a flash lamp as here shown so that its battery circuit could be closed either by pressing a push button carried on the belt, in the gauntlets, or by the pressure of the foot in a certain way.

Some months ago we chronicled in these columns the merits of a new-fangled electric foot warmer as used by the Pittsburgh, Pa., police traffic squad. We wonder if there is not some electric genius who would be so considerate as to invent an electric kit, whereby our friend the policeman can push a button and have his hot clam bouillon and coffee at any time.

The life of a Twentieth Century policeman will yet become a highly desirable and irresistible vocation thru the medium of that genie of all genii—Electricity.

THE ELECTROPHONE PRODUCES MUSIC ELECTRICALLY.

Herewith we present the *Electrophone,* an electrically actuated musical instrument. The action is absolutely unique and a departure from any used in similar instruments now being manufactured, the inventor claims. One of the principal advantages of the new action employed is that there is practically no chance for it to get out of repair, and no cumbersome dry cells

The "Electrophone"—A New Electrically Played, Tubular Musical Instrument, Which Is Here Seen Mounted on a Piano. It Employs a Separate Keyboard, Seen at the Right.

or storage batteries are required. It works equally as well on direct or alternating current circuits. It works nicely on A.C. thru a small transformer. The illustration shows it placed on top of a piano, but this is done merely as a convenience. It has no connection with the piano. The Electrophone runs three octaves chromatic and is played by means of a small keyboard attached to the piano and can be played singly or with piano accompaniment. The tone can best be described as "harp like" 'tho it is not a stringed instrument. The Electrophone presents a handsome appearance and provides a new piece of music for professional and amateur or home music circles alike. It was invented by Mr. Ingvald Brown, a genius from Idaho.

A REMARKABLE HIGH TENSION INSULATOR.

By Frank C. Perkins.

The accompanying illustration shows a remarkable high tension insulator developed at Detroit, Mich., which several power companies have tested under oil and punctured some at 300,000 volts; 200,000 volts being an average value for puncture strength of these discs. These insulators have stood high frequency flashover tests for one hour. Instead of the usual rigid, malleable iron caps and solid pins, two spider-shaped caps are used, whose eight legs fasten at a depth of one inch into the upper and lower sides of the insulator. The flexibility of the legs prevents expansion and contraction strains on the porcelain, absorbs shocks and distributes the tensile strain uniformly.

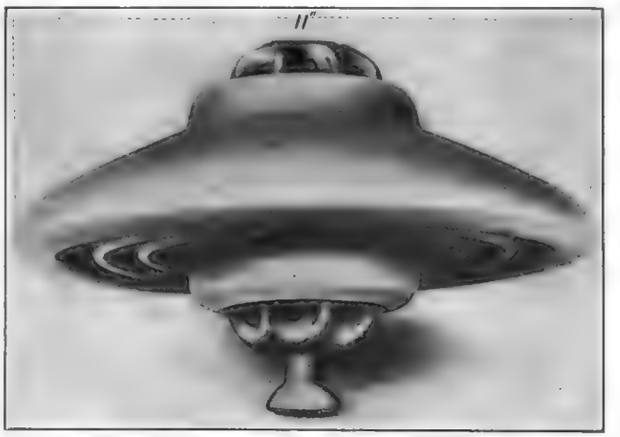
No cement is used on this insulator, the spider legs being anchored into recest holes in the porcelain by means of a special alloy similar to that used in die casting. This alloy, as applied, does not shrink away from the porcelain and has a very low coefficient of expansion. The insulator will stand plunging from boiling to ice water without harm. This test was made by several power companies.

This construction gives the disc an ultimate breaking strength of 8,000 to 10,000 lbs. The electrical properties have been proven not to be affected in the least up to the full breaking strain. In this disc the electrical and mechanical strains occur at entirely different parts of the porcelain.

The diameter of the unit is 11" and the distance between units assembled 6½". The dry flashover tests of one unit at normal frequency showed 97,000 volts and with two in series the pressure was 184,000 volts while three in series withstood 253,000 volts. In the wet flashover test (precipitation 1" in 5 min.) 50,000 volts was used and with two in series 92,000 volts, while four in series withstood 185,000 volts and with five in series the pressure was 220,000 volts. It is stated that the high frequency oscillator test gave a first arc-over value with one disc of 120,000 volts and with five units in series 500,000 volts.

In testing insulators each unit is mechanically tested to a strain of five or six thousand pounds, then it will be tested electrically to flashover for ten minutes on a 60 cycle transformer of the General Electric Co., type with a high frequency oscillator for 250,000 volts. As soon as this is finished the disc is tested on high frequency as it is better to find the weaknesses before putting the insulators on the line than afterward. This insulator when it is once put up, will not have to be taken down due to any di-electric or mechanical weakness in the insulator.

It is held that the disc has proven by tests, both on normal and high frequency to avoid corona up to 90,000 and even 110,000 volts, whereas a disc ¾" thick is under corona at 30,000 volts. Some experimenters claim to have observed it at much lower voltages. This disc will insulate permanently, because of its safe dielectric stresses and the perfectly balanced field is also very important in securing the full value of the insulating material and enabling the insulator to resist high frequency and other line conditions caused by lightning and switching.



A New Design of Insulator Which Required 300,000 Volts to Puncture It.

NOVEMBER MEETING OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 326th meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York City, on November 10th.

The meeting was well attended and was held under the auspices of the Committee on Economics of Electric Service and dwelt principally on the subject of Inventories and Appraisals. Three papers were presented bearing the following titles:

"The Effect of Recent Decisions on the Work of Inventory and Appraisal," by Dr. Philander Betts; "Continuous Inventories; Their Preparation and Value," by Harry E. Carver, A.B., M.E.; and "Growth and Depreciation," by Julian Loebenstein, E.E.

The papers were well received and were of particular moment at this time when the engineering societies and specially appointed Governmental boards are so busily involved in the general appraisal and inventorying of the country's resources in order to put the United States on thoro preparedness basis.

HOW THEY HEARD THE BELLS OF NEW YORK IN 'FRISCO.

You have all heard or heard of the various sounds that have been floating thousands of miles across the transcontinental telephone line for the past year—bell-ringing, surf noises, "Hello 'Frisco" quartets, and what not. Here is one of the best known entertainers—a bell on the lofty Metropolitan Building tower at Madison Square, New York. It has rung for thou-

How a Sensitive Microphone was Attached to a Large Bell in New York so That Its Sound Could Be Heard Telephonically in 'Frisco.

sands of people listening in on the transcontinental line. A sensitive microphone can be seen mounted to one side of the base. This is connected up with the local telephone exchange and as the bell is rung the sound acts on the microphone, causing variations in its electrical resistance and consequent fluctuations in the line current. These electrical pulsations fly along the circuit with the velocity of light or 186,000 miles per second, and finally they arrive at the receiving instrument where a transformation of electrical into mechanical energy occurs and we hear once more the toll of the bell, possibly 4,000 miles away.

NEW WIRELESS STATION ON AFRICAN COAST.

Military engineers are erecting a wireless station on Cape Juby, on the African coast, and expected to have it in operation before October first. In cases of need at sea the service will be available for ships in distress. As the big installation on Teneriffe Island is less than 100 miles from the Cape Juby plant, communication with the Canary Islands will be possible and, thru them, with the Spanish mainland. A regular steamship service to Cape Juby, with sailings from Santa Cruz de Teneriffe on the 28th of each month, has been announced.

WASHING DISHES BY ELECTRICITY.

The advent of the electro-mechanical dishwasher marks one more important step toward the passing of household drudgery. The process of washing dishes by the modern electric dishwasher here shown, is as simple as by hand.

You know that when you wish to sterilze a bottle you scald it, and when you desire to kill the germs in drinking water, you boil it. This dishwasher is sanitary because in using the machine the dishes are washt and dried in exactly the same manner, by scalding them with boiling water, therefore they are perfectly clean and done in a sanitary manner. This is a decided improvement over the old way of dishwashing by hand. The dish rag and dish towel that washes and wipes the first dish, generally washes and wipes the last, and unless the most scrupulous care is taken, the result is neither wholesome nor appetizing, and germs of disease are often the result. From a sanitary standpoint, the dish rag and dish pan have been severely criticized, and they are doomed to eventual elimination.

The distinguishing points of this electric dishwasher are its simplicity in construction, ease of operation and its thoroly satisfactory results. It rinses, sterilizes and dries the dishes and eliminates breakage and is so designed in its method of drainage that it automatically cleanses itself, not permitting of any accumulation of grease or food refuse.

From 40 to 60 pieces of tableware, depending on the size and style of dishes, beside the necessary knives, forks and spoons can be washt in one minute.

The container is cylindrical in shape and is made of heavy metal, the interior being so treated as to make it rustproof. The interior has a free cleansing surface, care being given in designing it to eliminate all pockets or projections liable to collect grease or food particles. The exteriors are finisht in white enamel. The bases consist of three iron legs firmly braced upon which the containers rest.

They are designed to have a connection to the water and gas mains for the purpose of giving a plentiful supply of water and gas, the latter being necessary to heat the water. The revolving grid and "dashers" are operated by two small electric motors. Attachment plugs and cables are provided in both types of machines for connections to the ordinary electric service mains.

A Typical Installation of a Light Service or Family Size Electric Dishwasher. Suitable for Placing in a Corner Where Economy of Space is a Factor.

SIGNAL LAMP INDICATES IRONING CURRENT "ON" OR "OFF."

One of the common curses of humanity is its well-known faculty for forgetting. The best trained memory will play treacherous tricks. The person who forgets what should or should not be done subjects himself to the proper penalty and pays it.

Often the user of an electrically heated device is suddenly called away and forgets to remember that current is on—so the device is left to its own destruction—or to do something worse.

Wherefore an enterprising genius has now favored us with a gentle reminder in the guise of the "Signalite" gap, designed for use with electrically heated devices of 10 amperes capacity or less to indicate when current is on or off. It is a combination of attachment plug and miniature lamp socket, constructed as a unit.

A miniature lamp is enclosed in an electrically welded guard and gives a warning light as long as current is on. The current consumption is so small that it does not lessen the efficiency of the device that is operated.

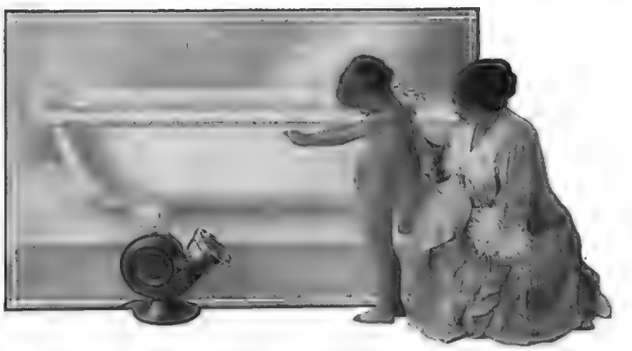
The device thus serves as a ready, steady memory jogger that cautions against forgetfulness when operating electric flat irons, soldering irons, toasters, chafing dishes, etc.

The light burns while the device heats. It attracts the eye, prods the memory and reminds the user not to leave the device to become overheated, thereby destroying the element or causing fire.

The General Electric Company has 14,830,000 square feet of floor space available for the manufacture of electrical machinery and devices.

AN ELECTRIC HEAT BLOWER OF MANY USES.

Instead of having to wait an hour or more in which to dry milady's tresses recourse may be had now to the combined electric blower and heater here illustrated. When little Willie takes a bath, make him feel good—evaporate the moisture from his body with a draft of heated air; a hundred and one other applications abound to which this sturdy little heat blower lends itself admirably. Wherever a steady blast of heated air at any desired temperature is wanted, this device will prove exceptionally welcome.



A New Household Convenience in the Form of an Electric Heat Blower. It can Be Used for a Variety of Purposes.

The blower element comprises a specially designed, multiple vane rotary drum which is mounted on the shaft of an electric motor of suitable size. The air passes over an electric heater grid placed in the discharge channel so that the emerging stream of air is nicely warmed. The complete unit is fitted with a handle for carrying about, and it may be connected with any convenient lamp socket.

HOW CIVILIAN ENGINEERS MAY AID THEIR COUNTRY.

On July first the new law providing for the National Reserve Corps of Engineers became effective. A general outline of this legislation was published in the March, 1916, Proceedings of the American Institute of Electrical Engineers, as reported by the Joint Committee of five national engineering societies which had been appointed to assist the War Department in the formation of the National Engineer Reserve. The War Department has recently completed details of requirements and qualifications for commissions in the officers reserve corps of the army.

Commissions will be issued for the rank of Major, Captain, First and Second Lieutenant. The commissions will be for five years renewable, however, with the approval of the Secretary of War and after a physical examination. Holders of commissions are subject in time of peace to duty in instruction camps and elsewhere of two weeks each year, or longer with the officers' consent, and it is expected that a reasonable latitude in the choice of time for this service will be allowed. They are subject to order to duty by the President whenever war is actual or imminent in a rank not below that held in the Reserve Corps of Engineers.

Reserve officers from the following civilian occupations will be required for the special services of the Corps of Engineers:

Bridge engineers.
Construction engineers (earth and concrete).
Constructing engineers (wharves, piers, and buildings).
Electrical engineers (for small plants and power lines).
Highway engineers,
Mining engineers (skilled in tunneling and use of explosives),
Railroad engineers (construction and maintenance),
Railroad operating officials,
Sanitary engineers,
Topographical engineers,

There is no maximum age limit for the Engineer Officers' Reserve Corps.

Engineers desiring to avail themselves of the opportunity thus presented for honorable service in the Army of the United States should at once send to the Chief of Engineers, War Department, Washington, D.C., for application blanks.

In smelting and preparing various high grade metals the electric furnace has many advantages, commanding as it does the very highest temperatures. The electric furnace is used for making the very highest quality of steel and for many special alloys. Not only does it give the very highest temperatures but with this type of furnace these very high heats may be readily controlled. Furthermore, with electricity there is no danger of contaminating the charge.

COLOR EFFECTS OF POSITIVE AND NEGATIVE RAYS IN GASES.

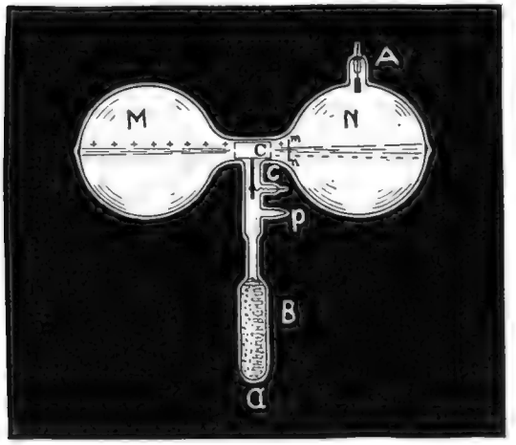
A new vacuum tube for demonstrating the color effect of anodic and cathodic rays in residual air, hydrogen, helium and other gases is described by Charles T. Knipp in *Science,* who, in conjunction with Dr. Jakob Kunz, designed the tube. It consists of a dumbbell shaped vessel as shown in the illustration and is formed of two 2 liter Florence flasks, M and N. The hollow, cylindrical cathode C is mounted in the neck, while A is placed in one of the bulbs. The cathode terminal C, the nipple P for exhausting and the charcoal bulb B are all attached to one vertical tube as shown.

After the tube is constructed and the charcoal bulb B is attached, the exhaust nipple is put in communication with a pump and also to a source of the certain gas to be used. The exhaustion is continued until sparking shows a tendency of becoming *hard.* As this stage is approacht, the cathodic rays will appear as a compact beam in the bulb N, while a beam of positive rays will traverse the bulb M. Now a small quantity of gas, say helium, is admitted. The chances are that too much gas will enter the discharge tube and thus destroy the definition of the two beams. To restore it, pumping should be continued and at the same time the bulb B should be carefully submerged in liquid air. The cooled charcoal will absorb the traces of air leaving the tube M, N, relatively richer and richer in helium—since helium, an inert gas, is but slightly absorbed by the cooled charcoal.

The cathodic beam as well as the positive ray beam in M, will each increase in brightness and definition, reaching a maximum, after which, as the process continues, they will begin to fade. At the stage when the beams are judged brightest the exhaust nipple P is sealed off from the pump. Removing the liquid air, the charcoal gives up its absorbed gas and the beams weaken and become diffused.

The most interesting phenomenon is the *color* of the two beams. The cathodic beam in helium is a greenish gray color, while the positive ray beam in the same gas is a beautiful red. There is no mistaking the colors. Indeed, the red due to the positive ions is so persistent that it appears at the very origin of these rays, at the edge of the Crookes *dark space* in front of the cathode (shown by the dotted lines m—n, in the illustration).

An interesting test to show that the beam in N is composed of electrons, and that in M of positively charged ions, is to deflect them in turn by a strong electro-magnet. The cathode beam is readily deflected, while the positive ray beam is but slightly deflected and that in the opposite sense. This is in full agreement with the theory of the magnetic deflection of moving positive and negative charges.



Interesting Scheme for Demonstrating the Color Effects of Positive and Negative Rays in Various Gases, Utilizing a Dumb-Bell Shaped Glass Vessel as Shown.

The chief difficulties encountered in experiments of this kind are that extreme care must be taken in exhausting the tube of air and proper precaution must be exercised in admitting the correct amount of gas into the evacuated chamber.

THE LIGHT SENSIBILITY OF COPPER-OXID.

The fact that selenium changes its electrical conductivity under the influence of light was discovered by May, in 1873. Since that time the property of light-sensibility has been lookt for in many substances and it has been found that sulphur, shellac, paraffin, anthracene and several other substances possess this property to a slight extent, says A. H. Pfund in *Science.* The most noteworthy addition to the list was made by Jaeger, who discovered the light-sensibility of stibnite (native Sb_2S_3) in 1907. Since a careful study of the behavior of these substances is bound, ultimately, to shed light on the mechanism of metallic conduction, it seemed worth while to continue the search for other substances which show marked light-sensitiveness. Recently the writer found that copper oxid (Cu_2O, presumably) shows the effect quite unmistakably.

Without going into details here as to the mode of production of copper-oxid cells or bridges, it may be stated that copper-oxid has a much lower specific resistance than either selenium or stibnite and is much the more transparent toward red light (layers having a thickness of more than 1 mm. are still slightly translucent). The fundamental facts which have been establisht for this new light-sensitive substance are:

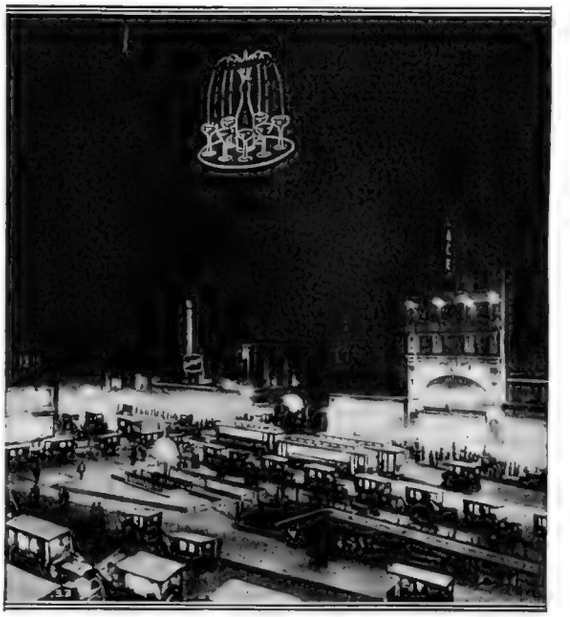
1. The conduction is electronic and not electrolytic.
2. The increase in conductivity, occasioned by light, is distinctly different from that produced by a heating effect.
3. The conductivity increases with the applied voltage, *i.e.,* Ohm's law is not obeyed (voltage effect).
4. The region of increased conductivity spreads slightly to portions of the material not illuminated (transmitted effect).
5. The region of highest sensibility not illuminated (transmitted effect).
6. The region of highest sensibility lies in the ultra-violet near 2800 A. U.?
7. Cooling in liquid air increases the percentage change in conductivity and displaces the sensibility maximum in the red toward shorter wave-lengths.
8. The relation between the radiant energy absorbed (E) and the resultant change in conductivity (C) is very approximately of the form $C=KE^2$ where K is a constant and lies near 0.5

While the percentage change in conductivity upon illumination is much less than that of selenium and stibnite, the comparatively high conductivity of copper-oxid makes the absolute increase quite large. The best cell which the writer has thus far constructed has a resistance of 15,200 ohms at 17° C. for 1 volt. The change in conductivity occasioned by the light from a 40-watt tungsten lamp at 20 cm. is about 15 per cent. The area exposed to radiation is about 12 mm². If this cell be connected to a 2-volt cell and a galvanometer (forming part of a simple potentiometer) a sensitive device for detecting radiant energy is produced. Exposing the cell to daylight in a moderately lighted room throws the galvanometer spot of light violently off the scale. Monochromatic radiations which are quite too feeble to affect a sensitive radio-micrometer, bring about large deflections when allowed to fall on the copper-oxid cell. If the cell be connected to a telephone receiver and battery and if an intermittent light beam of definite frequency be allowed to fall on the cell, a clear, musical note is heard.

The preceding discussion is to be looked upon as being of a preliminary nature. A systematic search for light-sensibility is being undertaken and a complete account of the work will appear later.

WATCH THE GLASSES FILL UP IN THIS ELECTRIC SIGN.

The accompanying photograph illustrates one of the latest electric signs on Broadway, New York City, which has been much admired. This gigantic and spectacular display is located at Broadway and Forty-seventh Street, where thousands of people are bound to see it nightly.



A Novelty in Electric Signs—The Bottle Effervesces as Shown and Fills the Glasses. It Extinguishes for a Moment, When the Action Is Repeated.

The illuminated bottle, representing a well-known drink, effervesces in the manner here shown, the various scintillating streams filling up the goblets. The glasses may be seen to fill up very realistically and as the "liquid" (composed of electric bulbs) rises near the top of the glasses the whole display is extinguished, only to be repeated in a few seconds.

The bottle in this sign stands 29 feet high, while the glasses measure 13½ feet, the tray being 43 feet long. The complete sign is lighted by 2,400 tungsten lamps which are controlled by special, motor-driven circuit-breakers.

Photo courtesy O. J. Gude Company.

The largest coal mine in the world at Nokomis, Ill., where one thousand tons of coal are taken out every hour, is entirely operated by electricity.

Reginald A. Fessenden—This Month's Supplement

REGINALD AUBREY FESSENDEN, the subject of this month's supplement, is thought by many as being the greatest living Wireless Inventor today.

To Dr. Fessenden belongs the great honor of having invented the first practical Wireless Telephone as well as scores of important apparatus used today in every modern radio station.

Professor Fessenden, was born in Bolton, Quebec, Canada, on October 6, 1866, the son of the Rev. E. G. Fessenden. He was educated at the De Veaux Military School, Suspension Bridge, N.Y., and at Trinity College School, Port Hope, Ontario, Canada, and at an early date manifested a particular liking for mathematical and scientific subjects. This eventually led into electrical and wireless channels and Professor Fessenden has since been busily engaged in extensive research work along these and allied lines. He was chemist-in-chief in Thomas Edison's laboratory from 1887 to 1890 and served in the following two years as electrical expert with the Westinghouse Company of Newark, N.J. He was elected professor of electrical engineering at Purdue University, 1892-1893 and served in a similar capacity at the Western University of Pennsylvania in 1893. He holds patents on many inventions in chemical engineering and has written numerous scientific papers. Dr. Fessenden married Helen May Trott, of Bermuda, in 1889.

He is the inventor and patentee of a number of practical and extremely original wireless devices, many of which are being used today with marked success.

Professor Fessenden was officially selected by the U. S. Government under the auspices of the Weather Bureau, in the year 1900, to take up a systematic investigation of the problems of radio-telegraphy. Early in 1901 the Weather Bureau officially installed him at Wier's Point, Roanoke Island, North Carolina, and from this and other points along the Atlantic seaboard, he carried out successfully a number of very important radio tests.

His researches proved fruitful and on August 12, 1902, there were issued to Professor Fessenden, 13 patents on miscellaneous methods, devices, and systems for transmitting intelligence without wires. These patents covered improvements in construction of antennae; method of localizing signals; special selective system; means of amplifying received signals; wave shute or wave gate for directive wireless telegraphy; method of localizing, generating and receiving two distinct sets of waves of different periodicity; wireless telephone; comprest air spark gap; a method of recording received radio signals on photographic paper, etc., etc.

He is known best in radio circles for his work in developing and perfecting his detector of wireless signals known as a *Barretter,* also the electrolytic detector and radiophonic apparatus. Several important inventions in the radio art which are always linked with the name of Fessenden are the special high frequency alternating current generators, developing frequencies in the region of 200,000 cycles per second, for the purpose of transmitting speech *via radio;* the synchronous rotary spark gap mounted on the same shaft with the motor-generator, now common in all wireless installations, especially on ships, the Heterodyne method of receiving and amplifying the incoming wireless impulses, by superimposing on the receiving circuit a current of slightly different frequency than that of the incoming wave; special designs of heavy current microphones for modulating the antenna current by means of the voice in wireless telephone stations; interference preventer for effectively tuning out different unwonted stations and excessive *static* (atmospheric) currents.

One of Professor Fessenden's extremely practical and timely inventions is an electrical system of submarine signaling which is applicable to submarines, warships and steamships, or between two points of land. The invention utilizes the principle of conduction of sound thru water. He has attained, in his experiments in this direction carried out in Boston Harbor and other points, both telegraphic and telephonic communication over distances of 8 to 20 miles and more, by setting up suitable and sufficiently powerful vibrations under the water. This is usually accomplisht by employing a powerful vibrator or oscillator secured to the metallic hull of the ship. These vibrations are thus transmitted thru the water at relatively high efficiency and are intercepted at any desired receiving point within range by ultra-sensitive microphones, similar to those used in telephony, which are mounted within a steel chamber filled with water and bolted fast to the hull of the receiving ship.

In the realm of radio-telephony Professor Fessenden is given credit for being one of the pioneers and early investigators of the gigantic problems here involved, who really did accomplish. Undoubtedly one of the first cases on record where speech was propagated several hundred miles thru space by Hertzian waves was that when Fessenden carried out his successful tests between Brant Rock, Mass., and Virginia.

The electric ferryboat crossing the Rhine between Godesberg and Niederdollendorf accommodates 645 passengers, besides vehicles, and is propelled by two screws, each coupled directly with a thirty horse-power series wound motor, making 300 revolutions per minute. The storage battery of 160 cells has a voltage of about 300 and a capacity of 335 ampere hours. The actual crossing time is about four and one-half minutes, and after eight trips in each direction the battery is recharged at Godesberg. The same battery feeds three auxiliary motors on the boat, one used for pumping and the two others operating the landing bridge.

MAMMOTH "ELECTRICITY" STATUE.

Crowds gathered daily recently to gaze skyward at the great statue of "Electricity" which surmounts the Fulton Street tower of the new Telephone and Telegraph Building at 195 Broadway, New York, as it was raised to the roof of the building on October twenty-fourth and swung into place on the pinnacle of the tower.

The statue was modeled by Miss Evelyn Beatrice Longman of New York and was the winning design in a competition in which eight sculptors participated and of which the judges were Mr. Theo N. Vail, Mr. Daniel Chester French, the famous sculptor, and Mr. William Welles Bosworth, the architect of the building.

The statue is of bronze and has been covered with gold leaf, as the natural bronze becomes blackened when exposed to the weather, so that it would not be practicable for the purposes of this statue. The figure stands 24 feet in height, weighs 16 tons and reposes 434 feet above the street.

On the roof at 15 Dey Street as the statue was being raised to its position stood a little woman whose fine dark eyes were watching the consummation of nearly a year's work, work too, which had been extended over twice twelve months, and more. It was Miss Longman, the creator of the statue.

Handsome Bronze Statue Representing "Electricity" which Surmounts the New Telephone and Telegraph Building in New York City.

Very little about the inspiration which had prompted the statue, very little about the idea behind it, would Miss Longman say, more than that she had intended to express the power of electricity, its service to mankind, and the intangibility and mystery of its nature. And after all what need for a verbal explanation, when every line and contour of the statue itself is eloquent?

Of the technical side, the artist was more ready to speak, and the considerations of height and mass, of the effect of distance—for the great figure can be seen only from a distance—which had had determining influence upon the proportions of the statue, showed how much of science as well as of pure art, the artist must command.

WITH THE FEBRUARY ISSUE

we will present another

SUPPLEMENT

of a famous electrical inventor. This is the fourth of a series promised to our readers.

These supplements are printed on fine art paper, ready for framing. They are invaluable to adorn your den, your wireless station, or your laboratory.

Order your copy now, to make sure you will get it.

NOVEL MAGNETIC CHANGEABLE SIGN.

We are all more or less acquainted with the little magnetic alphabet toy which was described in our December issue. This consists of a large number of curved iron strips supported in a suitable frame. By passing a small steel horse-shoe magnet over them, they are turned outward to produce a figure or letter. Practically any figure can be made with this device.

A Distinct Novelty in Theater Signs. Each Letter Is of the New, Magnetic, Interchangeable Type and by Means of a Steel, Horse-Shoe Magnet the Various Black Sections Can Be Pulled Forward so as to Form any Letter or Design Wanted.

The same principle has been recently utilized in a commercial sign. The only difference between the toy and the sign is that it employs a larger frame, which contains a considerable number of iron strips, so as to produce several letters. The accompanying photograph illustrates one of these magnetic signs as recently erected for a theater. The sign shown measures 20 ft. in length. When the time comes for the announcement of a new play, the operator who maintains the sign in proper order, simply passes a small horse-shoe magnet over the letters, thus setting the small black strips into proper position according to the letters desired. This unique sign, altho very simple in character, is a great time saver and produces a pleasing and satisfactory effect. *Photo Newellograph Co.*

RAILROADS COULD RUN ON "WASTE" OF COAL DUMPS.

Professor Charles Baskerville, head of the Department of Chemistry in the College of the City of New York, stated in a recent interview regarding the work of modern chemists:

"In any chemical problem there is no telling where the chemist will stop. Just now there are many chemists working on the problem of free gas. An immeasurable lot of power is wasted in the dumps of our coal mines. If this waste were reduced to gas by the retort process enough ammonia might be produced as a by-product to pay for the whole cost of the operation, making the gas free. The gas could then be used to generate electric power. Really, the Lackawanna Railroad ought to be running on the power it is now throwing away in these supposedly worthless dumps."

AN ORIGINAL AND EFFECTIVE MINE SIGNAL SYSTEM.

Recently a northern Michigan coal company equipt its shafts with a signaling system which is as effective as it is novel.

Confronted with a signaling problem in connection with their cage operations the mine officials cooperated with the Western Electric Company's engineers in the design of a special system as indicated above.

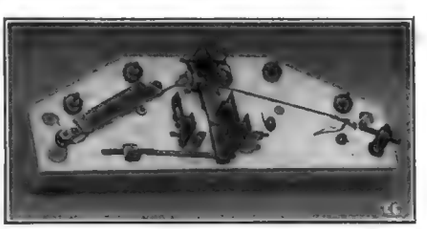
The system and its operation are simple, being essentially as follows: At each of the various mine levels loud-ringing extension bells are installed in pairs, each pair consisting of one six-inch and one eight-inch weatherproof type, loud-ringing gong. In connection with these bells, special switches are installed at each level. They consist of a telephone switch-book housed in a weatherproof cast iron casing. Attached to the switch-hook and hanging from the casing is a long leather strap similar to the well-known street car strap. Pulling this strap makes contact and rings the six-inch bells on every level and one in the engineer's room. When a man has loaded a car and wants it hoisted he pulls the leather strap a number of times—the number corresponding to a prearranged signal that corresponds to the operation desired. The bells ringing on each level in connection with the engineer's bell serves as a warning to the men on the various levels. The six-inch bells are on one circuit and the eight-inch bells on another—the latter being rung by the engineer when he is ready to hoist, or as a summons.

The wires of the signaling circuit are used for a telephone system, with a telephone set in the engineer's cabin and a set on every level. The system is simply a magneto party-line circuit and is used as a means of communication in connection with the signaling system between the various levels and the levels and the engineer.

The company has placed great reliance in its new signal system and has taken extreme precaution to keep it in uninterrupted operation. A supplementary circuit has been wired, so that if the ringing current in connection with the system should fail, warning bells will ring, summoning a repair man.

A DUPLEX THERMO ELECTRIC FLASHER.

The accompanying illustration shows one of the latest things in electric flashers which performs a double function with the same thermo-element. It consists of flexible iron rod supported between three points, as seen in the illustration. This is indicated by the wide rod. A fine high resistance wire is wound over this, the connections of which are made at each end. One end of this wire is connected in series with an external resistance coil, which is seen at the left. This coil is used to prevent excessive current from flowing thru the thermostatic coil.



New Thermo Flasher that Blinks One Lamp On and the Other Off, Repeating the Operation at Any Desired Speed.

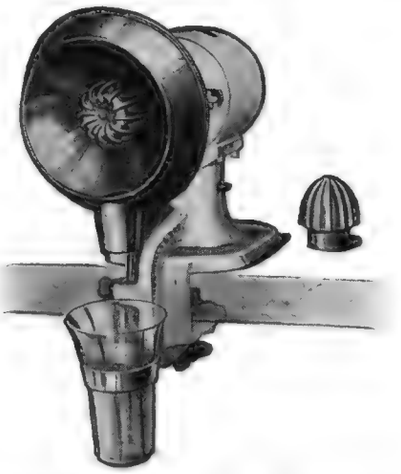
An insulator is placed in the center of this rod, connected to an arm of a long lever, which carries the control contacts. This lever is pivoted on a vertical upright, which is visible just behind the knob insulator of the V-shapt rod.

The thermostatic rod, the auxiliary resistance and the control contacts are mounted on a porcelain base. When current is past thru the device the thermostatic coil heats up, which expands the rod, and in doing so, it pulls the central arm, thus opening the first control circuit. The arm then closes the second circuit; at the same time no current is flowing thru the coil and thus it begins to cool, then falling back to its original position and closing itself. It will operate indefinitely providing, of course, the instrument is kept in proper adjustment. The tension of the thermostatic coil arm is variable by means of a knurled thumb-screw stationed on the right of the instrument.—*Photo Courtesy Betts & Betts.*

LEMON JUICE NOW BY ELECTRIC JUICE.

The electrically operated fruit-juice extractor illustrated has been perfected by a Philadelphia concern. This outfit is suitable for restaurants, soda fountains and all other places where it is necessary to extract the juice from large numbers of lemons or oranges quickly and efficiently.

It comprises a motor-driven hemisphere provided with ribs similar to the ordinary hand-operated glass extractor. The lemon or orange is halved and held against this hemispherical part. The juice is caught in a deflector at the back and runs down thru a spout at the bottom.



An Electrically Operated Fruit Juice Extractor. A Case of—When "Juice" Meets (Electric) "Juice."

A clamp is provided for quickly attaching the outfit to a table or counter and a ring is attached below the spout to support the glass. The outfit is equipt with 1/10 horsepower universal motor working on direct or alternating current lighting circuits. It will be found extremely useful in every household.

ELECTRIC LOCOMOTIVES FOR PANAMA CANAL HAULAGE.

Forty electric locomotives have been shipped from the Schenectady plant of the General Electric Co., to Panama, for the haulage of ships through the Canal locks.

AN ELECTRICAL CABINET OF WONDERS FOR PHYSICIANS.

We have all seen the magician put over his marvelous tricks and "mysteries," such as the box from which he proceeds to extract about everything imaginable—except

With This Complete Electric X-Ray and High Frequency Cabinet at Hand the Physician or Surgeon Is Prepared to Undertake the Treatment or Diagnosis of Most Any Case.

his salary. Well, the electric cabinet here illustrated and designed for our friend the doctor, is quite on par with those of Prof. Hermann, et seq. Among other things this physicians' electrical cabinet will supply a real X-Ray, high frequency or D'Arsonval current; also thermo-faradic, cautery, diagnostic lamps, air compressor—for aqueous and oily solutions—powder blower, hyperemia, cupping set, primary and secondary coil, etc.

The outfit includes 11 devices, and will accommodate attachments running to 14.

HAND SIGNAL LAMP FOR AUTO DRIVERS.

An electric hand lamp to make the extended hand of the driver an effective signal at night has been designed by a Pittsburgh electric concern. It is called the *Safety First* hand signal, and is worn the same as a wrist watch, only the elastic band which holds it in place fits around

This Illuminated "Safety First" Auto Signal Is Worn on the Hand by Means of an Elastic Band. You Can't Miss the Extended Hand at Night.

the hand instead of the wrist. It takes current from the socket in the dash-board through a very fine flexible silk cord. So little current is required that it can be burned all the time. Since every driver, instinctively, as a result of habit extends his hand to indicate his intention to stop, slow down or turn a corner, this lamp on the hand is a signal that nobody can fail to understand.

The miniature electric lamp is two candle power. It is enclosed in a polished nickel case, three inches in diameter and one inch thick. It is provided with a ruby bull's-eye one inch in diameter and throws a strong red light to signal to approaching cars the intention to turn. The bull's-eye is surrounded by the words *Safety First* cut out in white. Besides being effective as a signal to traffic, it enables the driver to get the immediate attention of the traffic officer.

The device is very light in weight and its presence on the back of the hand is scarcely noticeable.

AN IMPROVED MAGNETIC RECTIFIER OF SIMPLE DESIGN.

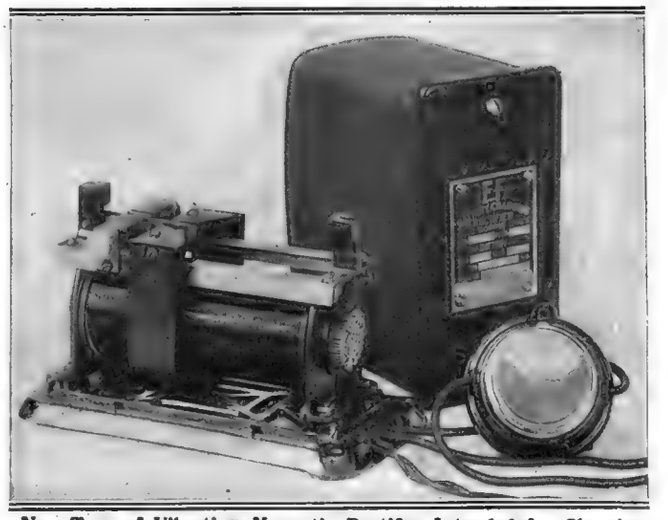
By Frank C. Perkins.

The accompanying illustration shows the design features of a unique magnetic rectifier recently developed at Cleveland, Ohio.

Among the many alternating current battery chargers in service may be mentioned this magnetic rectifier, which is a new and inexpensive device for charging small storage batteries of all types.

It is the constantly increasing use of storage batteries for a large variety of purposes that has created a demand for a charging device that does not require fixt conditions of installation, constant attention or expert knowledge, something that will charge storage batteries economically and conveniently.

In order to use the common alternating current house lighting or power circuit for charging a battery, some sort of a rectifying apparatus must be employed, which will cause all of the current to flow through the battery in the same direction. These conditions are met in the development of this new vibrating rectifier, as it will charge any battery of 8 volts or less, from a 100 to 125 volt, 60 cycle alternating current lamp socket, at an average current rate of from 6 to 8 amperes without any adjustment whatever.



New Type of Vibrating Magnetic Rectifier Intended for Charging Storage Batteries from A. C. Circuits at Home, at an Average Cost of Ten Cents.

It is claimed that the design here described, has overcome all inherent drawbacks in the existing types with their liquids, glass bulbs, sticking contact points, complicated mechanism, revolving armatures and current losses through resistance and a great step has been taken forward in the radical departure from these delicate and expensive apparatus.

There is a step-down transformer of special design used to reduce the line voltage down to the proper charging voltage. The core of the transformer is made up of many small soft iron wires, over which are wound the enameled copper wire primary and secondary windings. The low voltage charging current is passed through the rectifying element, consisting of a master spring armature, one end being rigidly attached to, and in magnetic relation to, the metallic end piece of the transformer core. The other end of the armature is free to vibrate between the fixt poles of a powerful permanent magnet. To the master spring are attached two opposing sub-springs, each of which carries a copper electrode which makes and breaks circuit with a carbon electrode. The light weight construction of the armature makes its action very positive and allows it to follow perfectly the alternations of the current, with its characteristic surges and variations in frequency.

It is pointed out that the powerful permanent magnet not only controls the vibration of the armature, but acts as a magnetic circuit breaker to open the charging circuit if for any reason the alternating current fails or is temporarily turned off and thereby prevents the battery from discharging through the rectifier. This rectifier is self-starting and upon resumption of the line current the charging circuit closes automatically and the charging is continued. It is entirely safe to put a battery on charge during the night.

The ampere charging rate also reduces as the voltage of the battery rises and the charge nears completion so that the battery will not be harmed by leaving it on over charge. Important advantages of the magnetic rectifier lie in the magnetic control of the armature of only one moving part and the non-sparking and permanent service of the carbon and copper electrodes where the rectification takes place. Carbon being infusible, will not roughen or stick and this, together with the feature of being able to adjust the carbons for any wear by simply turning a thumb-screw, makes them serviceable for long periods after which they can be renewed at very little cost. Other than this there is no maintenance expense or depreciation. The current cost per charge for the average battery is only from 3 to 15 cents.

As to the efficiency, it is claimed that this rectifier utilizes the negative as well as the positive alternations of the current which causes a steady undirectional current to be generated which will charge all types of storage batteries and operate other direct current apparatus. It will run continuously at full load and complete a charge in exactly the same time as though the battery were being charged from a direct current source.

In order to operate the rectifier, it is only necessary to screw the extension plug into any convenient lamp socket and turn on the current. The positive (+) and negative (—) wires from the rectifier are then attached to their corresponding binding posts on the battery when the ammeter will indicate the proper charging current.

Recent Electrical Novelties

A NEW CHANGEABLE ELECTRIC SIGN FOR STORE WINDOWS.

Electricity is one of the few forces of nature that can be used to advertise itself as well as other goods. Now the Southwest Retailers' Advertising Corporation,

An Attractive Electric Sign for Store Windows. It is Equipt with a Tungsten Lamp and Flasher for Each Compartment.

an organization composed of retail merchants for the purpose of co-operating with manufacturers of food products in connection with their local and national advertising campaigns, has adopted what is known as the Gritt electrical fixture, a patented, interchangeable, electrically illuminated advertising sign.

The fixture has seven separate compartments or sections, each section operated with an individual flasher and illuminated with a 20-watt Mazda tungsten lamp.

The advertisements are photographic, hand-colored, transparent plates, 10 by 14 inches. Merchandise trademarks or packages are reproduced in original colors on these plates or slides. The various transparent colors with the electrically illuminated flash arrangement, give a very attractive display; one that has been found especially effective in groceries, meat markets, delicacy establishments, etc.

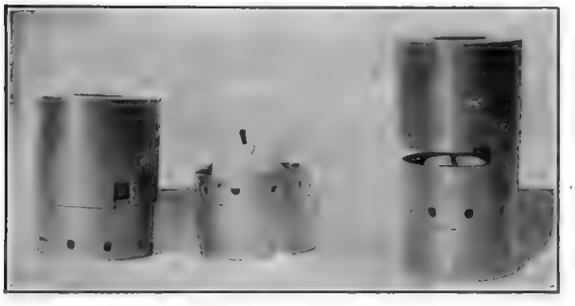
One of these fixtures is furnished to each member of the corporation, which has well over 1,000 members.

Local electrical contractors in each city are given the exclusive contracts to look after the installation and repair work of all the fixtures installed. These contracts run for five years and the electrical contractor is paid a fixed amount for each installation and a certain amount per month for looking after the repairs and slide changes and inspecting the fixtures, depending on the number furnished in the locality.

A NOVEL SOLDERING LAMP.

The accompanying illustration shows a soldering lamp designed for the use of linemen and electricians generally, but more especially for linemen working on telephone wires as there was no device that would perform the work satisfactorily.

The soldering iron is very slow and not efficient as it will cool before it can be taken to the top of a pole and a poorly soldered joint is the result; as for open flame lamps they cannot be considered as they will not remain lighted in a wind and if they do the flame will be so deflected by the wind that the wire will not become heated enough to solder. At the right we see the lamp with top extended to admit wire through slot at center. At left the candle holder base section is to be seen as well as the appearance of the lamp closed. The solder may be fed in at the top and the wind cannot blow out the flame, it is claimed by the inventor.



It Is Easy to Solder a Wire Joint in This Enclosed Candle-lamp Recently Invented. Can be Used as a Light Also.

RADIO WARNS SHIP OF HURRICANE.

The steamship *Tivives,* of the United Fruit Line, was saved by the wireless service of the New York *Herald* from the hurricane which recently destroyed the United States cruiser *Memphis,* off the coast of Santo Domingo. The passengers also expressed appreciation of the daily news bulletins supplied by the *Herald's* service.

Eugene Magnus, one of the passengers, said that when Capt. A. D. Livingston, commander of the *Tivives,* received the wireless warning he put into a pier at Havana and remained there, coaling, until after the danger from the hurricane had passed.

"It is customary," he said, "for ships of the United Fruit line to anchor in Havana Harbor, some distance from the shore. But this time the Captain evidently decided that it would be safer to tie up to a pier and take on more coal to be doubly prepared for the storm. When we did get out only the rear end of the storm remained in our path, and this was so skilfully skirted by the *Tivives* that we experienced scarcely any inconvenience from it at all."

ELECTRICALLY HEATED HAND PALLET FOR BOOKBINDERS.

One of the latest aids to modern bookbinding is an electrically heated tool which is designed to take the place of the hand pallets largely employed in the bookbinding trade and usually heated over a gas stove. The electrically heated pallet is advantageous because within a few minutes after the current has been turned on all the heat that is needed is produced and the temperature of the device can thereafter be maintained constant. Of course with the electrically operated pallet no interruptions in the work are necessary for heating, as in the case with those pallets which are heated on a stove. The saving of time thus effected allows for a larger production within a given period. Furthermore, there is no dirt, as is the case when the pallet is heated on a gas stove. The type employed with the pallet can be easily and quickly changed, it is declared, a half turn of either one of the thumb screws shown in the illustration herewith releasing it, as the jaws work in opposite directions on a left-hand and right-hand screw. As it is made mostly of aluminum, the pallet is light and easy to handle. Special provision has been made to insulate the wooden handle thoroughly so that it is possible to operate the device continuously without any discomfort from heat. The energy consumption is small, only 110 watts being used. The device is designed to operate from an ordinary lighting socket and the heat controlled by a small rheostat.

Bookbinders Will Find This Electrically Heated Pallet of Extreme Convenience and Efficiency.

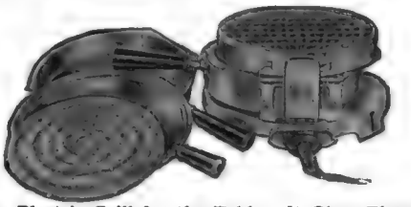
UNIQUE ELECTRIC GRILL FOR THE TABLE.

The electric *table range* has come to stay. In their eagerness to meet the demands of the household goddess for a table range that will do away with all guesswork in the adjustment of the heat to the various cooking operations, an enterprising manufacturer has placed on the market a new three-heat Radiant Grill.

This Grill operates from any lamp-socket, and cooking can be done both above and below the glowing coils—a great convenience and economy. It is equipped with three heats in such a way that it is a very simple matter to adjust the heat to the user's needs. The switch-plug is simply inserted at the different points in the plug receptacle marked *High, Medium* and *Low,* using 600, 300 and 150 watts respectively.

The "burner" is supplied with a heating element of very rugged design, of the open-coil-reflector type. It is made of exceptionally heavy gauge resistance wire and supported by high-grade mica insulated cross-bars. These bars are reinforced and protected by metal cross-rods which form a very strong grating for the cooking surface.

The Grill is made of heavy pressed steel, and every part finished in highly-polished nickel. It is furnished with two dishes, deep stew-pan with broiling grid, and shallow dish. Also reflector (to concentrate heat on one operation) which may be used as a cover, and for a cake griddle. These dishes may be used either above or below the coils. Ordinary cooking utensils may also be used on it with equally as good success.



An Electric Grill for the Table. It Gives Three Degrees of Heat.

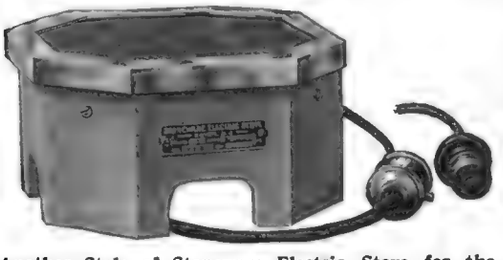
STONEWARE ELECTRIC STOVES THE LATEST.

Stoneware electric stoves and heaters are the latest in the line of every-day appliances of this nature. The tallest model here shown represents a combined stoneware heater and stove, the smaller model that of a stove for light cooking.

The Latest in a Combined Electric Heater and Stove. It Presents a Most Pleasing and Artistic Appearance and Is Fitted with a Switch in the Attachment Cord.

The body of these stoves is made of a specially prepared, comprest asbestos composition, capable of withstanding high temperatures. They are supplied in all shades of slate gray and reddish brown, smooth finish, or of raw tan, rough finish. The latter looks particularly well with fumed oak furniture. The heating element is made of flat Nichrome resistance ribbon. This has a considerably higher working temperature than the ordinary wire, such as is generally used for heating devices.

In the cooking stove (lowest one shown) every precaution is made to confine the heat to its upper face. The amount which can escape thru its sides and bottom is negligible and the heating wires are placed as near to its top as possible. As soon as the current is turned on heat is radiated to the object to be heated by the red hot wires—at least by the upper half of them—their lower side radiates its heat down to the upper face of the stove—called its radiating partition—for it is simply a partition of asbestos board (especially prepared to stand high temperatures), backed by air cell asbestos, to stop any heat from passing down. This radiating partition becomes hot and in turn radiates its heat to the object to be heated, so that soon the heat radiated down as well as that radiated up goes to heat the object on the stove. Asbestos absorbs so little heat as compared to metal, water and other substances, that it takes but little to bring it up to a high temperature. The combined electric stove and heater is supplied for various wattages, as also the smaller model electric stove, the amperage ranging from 1 to 6 at 110 volts.



Another Style of Stoneware Electric Stove for the Table.

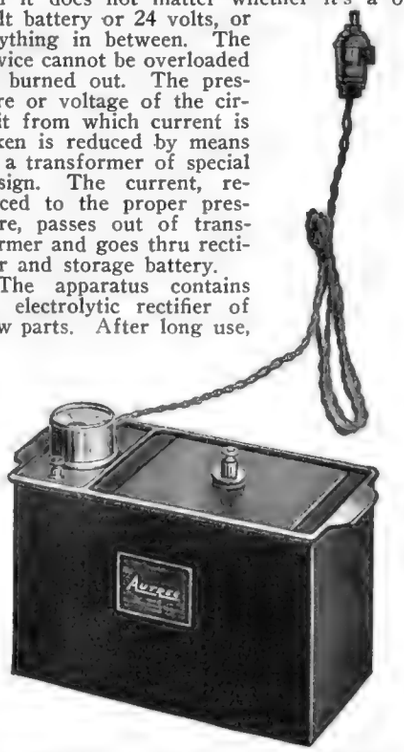
A NEW TRANSFORMER-RECTIFIER FOR CHARGING BATTERIES.

The apparatus here pictured is a device that enables you to charge a 6, 8, 12, 18 or 24 volt storage battery from an alternating current circuit, by screwing the attachment plug in any socket where there is alternating current. Then two wires are run from the proper terminals to the storage battery to be charged. The latter may be left on the car. When the socket key is turned the battery will receive a direct current.

The instrument passes a current of about two amperes or a little lower if the voltage of the battery is high. With this current, you can charge a battery of any ampere-hour capacity if time is not limited. A charging over night will put a discharged battery in serviceable shape, and if the latter is of large ampere-hour capacity, the current may be left on long enough to effect a complete charge, or it may be put on at different times and the same result accomplished. Charging the battery at regular intervals is very good practice.

The charging set is completely automatic in that there are no regulating appliances, and it does not matter whether it's a 6 volt battery or 24 volts, or anything in between. The device cannot be overloaded or burned out. The pressure or voltage of the circuit from which current is taken is reduced by means of a transformer of special design. The current, reduced to the proper pressure, passes out of transformer and goes thru rectifier and storage battery.

The apparatus contains an electrolytic rectifier of few parts. After long use, depending upon amount of work done, one electrode will be consumed and a change of fluid required. Replacements can be made in a few minutes' time at a cost that will be equivalent to not more than five cents for the full charging of a 60 ampere-hour battery, it is claimed. It is about the same in size as the average automobile lighting storage battery, 6¼ inches wide by 12¼ inches long by 11 inches high, weighing 45 pounds, and can be carried in the car for use while touring. A direct-current ammeter secured to the cover forms part of the circuit and indicates at all times the charging current passing into the battery.



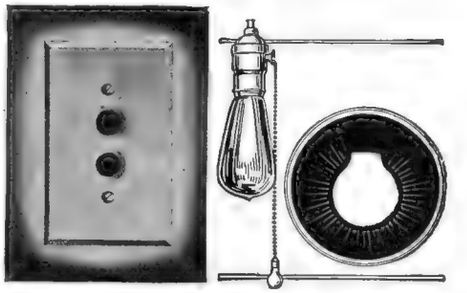
Something New in Battery Charging Devices—A Self-Contained Electrolytic Rectifier, Step-Down Transformer and Ammeter.

NEW LUMINOUS SWITCHES AND SOCKETS SHINE IN DARK

There is something new under the sun at last in the form of self-luminous electric switches and sockets which glow in the dark and are thus easily found.

The small bulb attachable to chain pull sockets is permanently luminous and can be plainly seen all night if left hanging during the day where it can get light. Artificial light will also cause the bulb to shine.

The use of this bulb will save a great deal of wiring expense, and will make pull chain lighting more popular than ever,



Have You Found it Difficult to Locate the Electric Switch or Lamp in the Dark? These Luminous Switch Buttons and Pendants Glow in the Dark.

say its sponsors. No more swinging around in circles to find the chain; no striking matches to find the light.

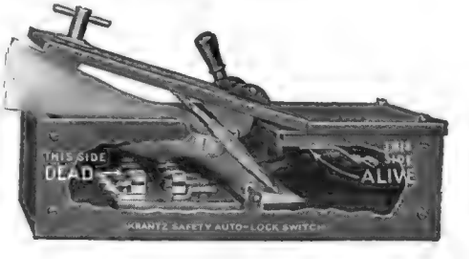
MARRIED BY TELEGRAPH.

Private B. J. Linhart of a Missouri regiment at Laredo, Tex., and Miss Ruby Swartz at Butler, Mo., were united in marriage by telegraph recently, thru the intermediary of an operator and a clergyman at each office. After the ceremony the bridegroom was showered with rice by his brother guardsmen.

A new hydro-electric power plant has been opened and placed in service in Utah, where energy is transmitted to Salt Lake City, 135 miles away.

SHOCK IMPOSSIBLE WITH THIS SWITCH.

A new electric service switch known as the Safety Auto-lock Switch, shown herewith, effectually precludes the possibility of the manipulator receiving any shock whatsoever. In this switch, the movable part of the switch is attached to the cover of the inclosing box in such a manner that the box cannot be opened when the switch is closed. Furthermore, *live* parts cannot be touched when the cover is opened, since a barrier is swung into place between the *live* terminals and the open end of the box when the cover is raised. With the cover raised the fuses are always left dead. Holes are provided in the lugs on each side of the switch-handle so it may be held in the open position with a padlock. Means is also provided for locking the lid of the box closed. All parts are interchangeable and the blades can be replaced without disturbing the wiring connections.



This Switch Automatically Disconnects the Current When the Cabinet is Opened.

Three electric passenger busses run to outlying districts in Dubuque, Iowa, as adjuncts to the existing trolley system.

DIPLOMAT OBEYS WIFE'S RADIO PLEA FOR A HAT.

Señor Julio de Betancourt, Columbian minister to the United States, performed a delicate mission aboard the United Fruit liner Almirante recently which won him the admiration of all on board. Acting on wireless orders from one of his superiors, he met the ship at Quarantine, gingerly carrying a large box. A steward hurried with it to one of the staterooms, while Señor de Betancourt anxiously paced the deck.

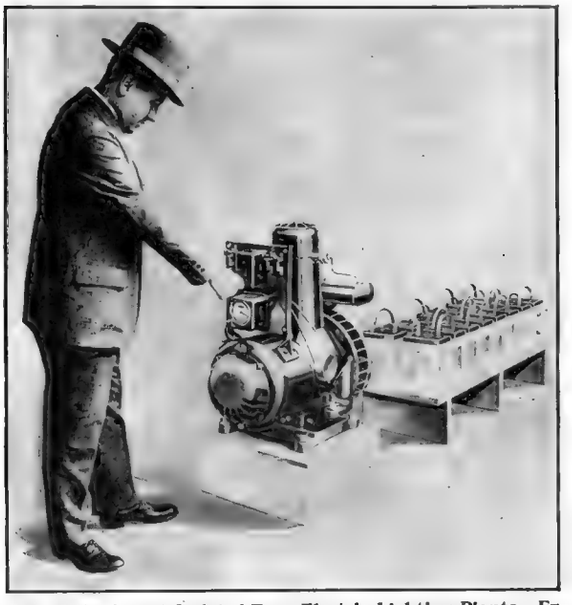
Presently the stateroom door opened and out walked the minister's wife. She wore a brand new Fifth Avenue spring hat and beneath it a happy smile. The diplomat saw the smile and breathed a sigh of relief. His wife had lost her hat overboard, he explained, and sent him this wireless message:

"Lost hat. Meet me at ship with new one."

A COMPACT ELECTRIC LIGHTING OUTFIT.

The accompanying photograph illustrates a very compact electric generating unit recently developed. This is intended for private use where power lines are not available, such as in suburban sections of the country.

The complete outfit consists of a gasoline engine of the air-cooled type, directly coupled to a dynamo. Over the dynamo, the switchboard is mounted. Upon this panel are arranged the various controlling devices. The generating output of this unit is 750 watts at 32 volts. The engine is started by closing the battery switch which connects the dynamo to the battery, thus causing it to act as a motor momentarily. The engine is started as soon as the proper speed is attained. The motor connection is automatically thrown out of the circuit, and the dynamo line is switched in so that it charges the storage batteries, used as reservoirs of electrical energy. A special ampere-hour clock is supplied on the switchboard to indicate the condition of the storage battery, whether in a fully charged or an uncharged condition. Thus the person operating this outfit can tell at a glance the amount of current he has already consumed and when it is again necessary to charge the batteries. The size of the complete outfit can be compared by the size of the man standing near the switchboard. This outfit should find many friends among the country folks, farmers, and suburbanites.



One of the Latest Isolated Type Electric Lighting Plants. Extremely Complete Even to an Ampere-hour meter.

Newport's Radio Float

By Lloyd Manuel

When plans were being formulated for the Fourth of July preparedness parade held in Newport, R.I., the author suggested to the committee in charge that a float featuring *Radio* as a preparedness measure, be displayed. The committee requested that he design and build such a float, with the result here pictured.

A Wireless "Float" of More Than Passing Interest. It Appeared in a Parade at Newport, R. I., Recently, and Created a Very Favorable Impression.

As it was a daylight parade, the author did not feature the transmitting end as much as he might have, had the parade been held at night. A beautiful effect could then have been obtained.

The transmitting set consisted of a one-inch coil charging a moulded type condenser which discharged through a fixed gap. On account of their portability and due to the fact that the parade was of but two hours' duration, dry cells were used. A spark which could easily be heard a thousand feet in the open air was obtained. In addition to this an auto vibrator buzzer was used. When the spark was not being worked, the buzzer was kept going, spelling out patriotic items. For the display, an E. I. Co. Tesla coil was mounted on the table, also two inductive helices. Also a Blitzen key and a Fessenden commercial key was used. An Edgecomb-Pyle Rotary and close core transformer were shown.

For receiving the writer requested the use of the sets belonging to "1TD" and "1TG." They readily acquiesced and thus the two finest Audion sets in this section of the state were obtained. These sets are made of solid mahogany with a hard rubber front and are a great credit to their owners, who are also the designers. They are excellent pieces of work and enhanced the beauty of the float.

The aerial, consisting of four polished copper wires, was supported between two nine foot latticed towers, and was of the inverted "L" design. Electrose insulators were used at either end. Four operators were seated at the operating table—Arthur W. Manchester dressed as a soldier, Harry Tilley as a sailor, Charles G. Cook as a commercial operator, and the writer as the amateur. Mr. Manchester is one of the best amateur operators it has been my pleasure to meet and has a worthy second in Mr. Tilley.

When this float put in its appearance the population received it very enthusiastically. The applause along the route was constant and satisfied us fully.

WIRELESS JOBS FOR BLIND SOLDIERS.

It is an established fact that the blind far excel in acuteness of hearing and sensitiveness of touch their fellow men who have unimpaired sight. The French, with their usual forethought, have taken this into consideration in planning for occupations for French soldiers after the war. French scientists, after careful investigation, have decided that blind soldiers will make the best wireless operators.

The qualities most needed by a wireless operator are highly developed faculties of touch and hearing. In most cases, people who have been rendered blind not only retain those two faculties intact, but develop them to a remarkable degree of acuteness and sensitiveness.

Another valuable service which the French scientists believe the blind soldiers could render especially well is that of detectors on shipboard during a fog. Where a man with unimpaired sight is at a loss to locate the vessels whose fog horn he hears in the darkness, a blind man with sharpened hearing could locate it absolutely.

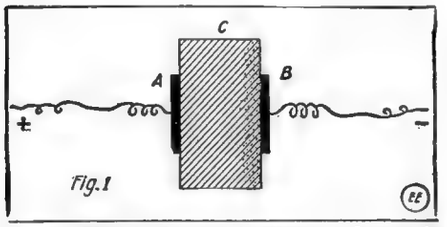
In opening these positions to her blind soldiers, France will not be performing any charity in the common use of that term. She will simply be fitting the best man to his job, and giving the men who fought for her their deserved opportunity. The benefit derived will be for the public as well as the individual.

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

Opportunities for the Experimenter.

THERE are more opportunities in scientific work today than ever before in the world's history. The ever-widening circle of scientific knowledge has grown in the last century by leaps and bounds, until it now touches a multitude of fields and an infinite number of problems. If the old



How an Electric Current Applied to a Dielectric "C" Causes a Soaking Effect; the Dots Representing the Electrons. One of the Mysteries of Electro-Physics.

saying that there is always room at the top was ever true it certainly is with respect to the scientific professions, for the more there are at the top, the more room there seems to be. The difficulty, as in all other walks of life, is to reach the top, and the present paper which concludes a series of twelve on special subjects in modern Physics would aim to show what is actually being done today in Physics and what the requirements of such work are.

A few years ago Lord Raleigh noticed a very slight difference in the behavior of nitrogen gas extracted from the air, and nitrogen obtained by other chemical means. A careful investigation proved that nitrogen from the air contained an extremely small proportion of a very rare gas existing in the earth's atmosphere, and hitherto unknown. This gas he called *Argon*, and already its discovery has proved of both theoretical and practical importance. It was the first of a series of new elements to be found which are chemically inert—Argon, Helium, Neon, Krypton and Xenon, and it is now being put in the latest incandescent lamp bulbs on account of the improvement it makes in the quality of the light. All this resulted from Lord Raleigh noticing a *slight difference* between two samples of nitrogen.

Quite frequently it happens, as in the above case, that a great scientist is not one who possesses an extra sense enabling him to look far into the future, and reveal what is hidden there; but that he is one who has trained himself *to note minute differences*, and to investigate the actual causes of phenomena. Just as Sir Isaac Newton watched a falling apple and discovered the universal law of gravitation, so may some scientist at this very moment be on the high-road to fame thru his attention to what others have past over as too insignificant or too commonplace to investigate.

Few of us, however, will ever become famous scientists, and not a large number will even be able to spend very many years in a university studying and preparing for such work. Consequently it is well that there are several avenues of approach, and that there is a place for the man of practical experience, and mechanical ability, as well as the man of theory—for both qualities are seldom found to the same degree in one individual. A striking example of what two individuals of opposite abilities may accomplish together is shown by the work of Henry A. Rowland and his assistant, a man of marvelous mechanical ability. Rowland himself invented and developed the theory of the concave diffraction grating, an optical device by which he was able to measure the length of light waves to the thousandth of an Angstrom unit.* This grating consists of a concave metal mirror upon which are actually ruled an immense number of very fine lines which act as parallel bars, prohibiting the passage of the light except between the lines. The great difficulty was to rule these lines accurately, but after many failures a machine was produced that would rule as many as 43,000 lines to the inch. So delicate was the machine that the temperature of a person in the room affected it, necessitating its operation in isolation, and other American and European scientists attempted in vain to imitate it. Rowland and his assistant, Schneider, died some fifteen years ago within a few weeks of each other, but their work will live, and it is interesting to note that only recently has a successor been able to manipulate the machine which Rowland and Schneider so skillfully constructed and used.

New Experimental Physics Series

The February number of THE ELECTRICAL EXPERIMENTER *will contain the first installment of a new series of "Experimental Physics" prepared by Professor John J. Furia, A.B., M.A., F.K.S., instructor of Physics in a leading American college and who possesses the faculty of writing easily understood articles on the every-day applications of the fundamentals of pure physics.*

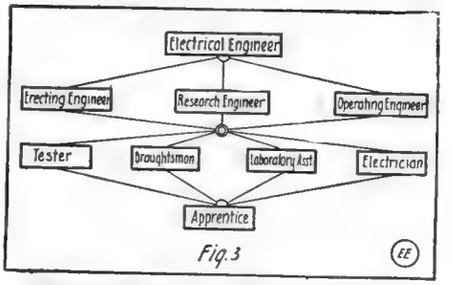
The series will continue thru twelve installments, each one dealing with some vital and interesting physical phenomenon such as—Photography, Magnetism, Electricity, Hydrostatics, Newton's laws, etc., etc.

This series of articles we feel sure will meet with the approval of all of our readers, as extremely simple experiments are given in each chapter which any one can perform, so as to satisfy themselves of the physical laws involved at an insignificant cost, and in most cases with odds and ends found about the household.

We believe that such a series of articles will be of more than ordinary interest as "Physics" represents the basis of all scientific phenomena and the practical every-day applications thereof.

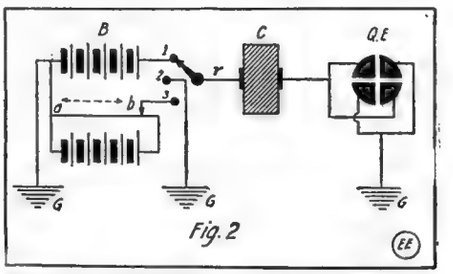
Every student of electrical and associated subjects must perforce have a well-grounded education in the elements of Physics and be able to express himself on these.

To mention the problems in scientific research awaiting solution would be an endless task, but a suggestion of the general fields of research may be more profitable. Among the greatest physicists of recent years may be mentioned Thompson, Einstein, Planck, Lorentz, and Rutherford. Thompson has directed untiring efforts in an attempt to solve the question of the constitution of matter. His study of *atomic structure* is monumental. Rutherford has attacked the same question from the field of *radio-activity* and is the world's highest authority on this subject. Planck has suggested a new theory of dynamics, the Quantum *theory*, which is now in its infancy, from his study of radiation. Lorentz and Einstein are known for their mathematical research, the latter having presented in 1905 his so-called *principle of relativity* in which he attempts to define the relation between the ether and the motion of the earth. His theory, however, is deeply philosophical and mathematical. These men have attacked directly the biggest possible questions. They are the same old questions as to the real character of matter, ether, and electricity, and we will probably only approach their solution so long as scientific research continues. Several eminent philosophers and scientists have said that we should not attempt to formulate such theories about the ultimate nature of things and their relations, because they cannot be proved, and that science should content herself merely with describing and analyzing the facts of experiment.



Showing the Paths Leading to the Title of "Electrical Engineer."

*Note.—Altho an error was subsequently found in Rowland's work, much of it is still standard.



Manner of Measuring the "Soaking Effect" of Dielectrics with a Quadrant Electrometer.

Others in the scientific world have been attacking these same problems indirectly by trying to further our knowledge of many important but little understood phenomena. For example, the *soaking effect* in a condenser has long been a mystery, and several eminent scholars have been studying it recently. As everyone knows, a condenser does not conduct a direct current, but stores up a certain charge on its surface. This is all very plain, but it has also been noticed that a certain amount of the charge disappears from the surface. If such a condenser is composed of two plates A and B and a dielectric C, Fig. 1, it has been found if the plates are charged, and then suddenly discharged to earth, that a minute current can be obtained for a short time from the dielectric itself. The small part of the charge which disappeared from the surface *actually soaked into the dielectric*, and now soaks out again in the opposite direction to that which it went in. This effect was first noticed some time ago by Curie and others, and recently Richardson has measured the voltage of this soaking current in quartz and Iceland spar. He calls it the polarizing E. M. F. of the crystal, and of course it is extremely small and varies with the applied E. M. F. His method of measuring the polarizing E. M. F. is comparatively simple.

The apparatus is arranged as in Fig. 2, so that by putting the switch on point 1, the condenser is charged by the battery B. The

(*Continued on page 691*)

The Presidential Amateur Radio Relay

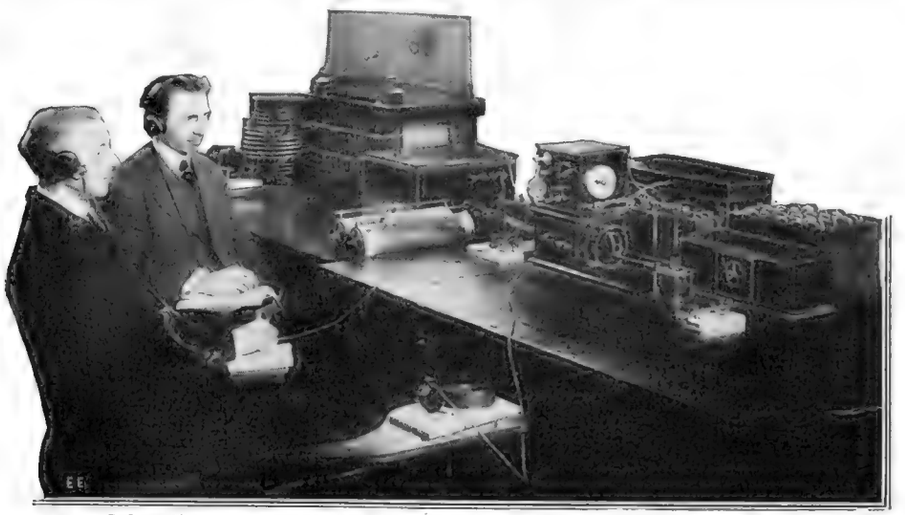
A Message from the "Big Chief"—9XE

THREE hours of real wireless fun and testing of various receiving apparatus was offered to you on the night of October twenty-seventh, Radiobugs. From the great amount of interest that was shown we are led to believe that it is the kind of work you like.

For the benefit of a few doubting Thomases in the east, we want to state that the permission to run this relay was received from the White House direct, from the secretary to the President of the United States. The Acting Secretary of the Navy, the Hon. Mr. Benson, also gave the permission and it was referred to him from the White House before we received the open order to go ahead.

Every amateur in this country was communicated with, direct or thru his Radio Club or another station in his town.

NAA and NAJ did not send out the warnings as planned because we withdrew the request when we were convinced that some were trying to make this a political move. Events have proved that if their contention was correct, that we not only know all about corn and crops out here but sure do know how to pick a winner against heavy odds. From the many thousands of signatures that we have on file it also appears that we innocently re-elected the President.



Prize Winner of Presidential Relay—Peabody High School of Pittsburg, Pa.

The relay was started by 9XE, who transmitted with a one-half inch spark coil connected to a regular oscillation transformer of the pancake type. The coil was going all along, and for a sending wave we had about one-half of the O.T. short-circuited by the sending key when it was prest. This compensating wave past thru the regular telephone wires, and as the receiver was off at 9XE, and also at 9XR two miles away, the wave worked the Hall *wireless relay* device, which is a sound actuated relay, and this automatically sent the message by working a magnetic key at 9XR.

The relay as conducted was perfectly fair and was open to all radio amateurs broad enough to see the advantage of it. The main idea of the relay was to obtain some idea of the "real range" of the various sending stations under adverse conditions.

Every sending station had a copy of the MSG (message) ahead of time and had instructions to repeat a certain letter in a certain marked word, and all had different marked words. By this means not even the writer knew the exact word letter that would be repeated. Some very remarkable distances were covered and some excellent receiving records made.

A great many Government and commercial stations were working at the time of the relay as well as numbers of amateurs, who appeared to be wilfully interfering. Thruout, however, the results were most gratifying and interesting.

No special interests were served in this relay as far as the writer knows, but one or two were ignored because the writer did not care to have anyone receive the credit for running the relay, as they did on the Washington's Birthday Relay of last year.

I am not trying to commercialize your interest in the relay work, and there is no string tied to the prizes. Neither are you urged into a mad race for subscriptions for this or any other magazine to earn this prize. It is human nature to enjoy a pat on the back for work well done, and that is what you are getting now. Bigger and better prizes will be offered later on to the best amateur station in the country for all around work, so you had better get busy. And don't forget that the author is assuming all responsibility about giving the prizes.

Incidents of the Relay

P. Stover, of Marengo, Iowa, claimed to have heard 6SH and 1ATY. The first station is in California and the latter in Connecticut. Not checking the mistakes cost him his chance for a good credit. Chester Sinnett, who lives on Bailey Island, off the coast of Maine, clearly read 8AEZ and 4DI, checking their mistakes and earning two good credits.

Station 5DU in Dallas, Texas, was clearly read by the author and did remarkable work. For sending the stations are listed as follows in the order of their apparent superiority—8AEZ, 8NH, 5DU, 9ABD, 6SH, 8NF, 9IC, 8JZ, 7YS, 7ZS, 2ZB, 8SK—and we came very near forgetting 9IK, which is really fourth on the list. A look at the list will explain the game better. 9DK, Oneill of St. Louis, volunteered to take the place of 9ACE, who was called away at the last moment. Emmerton of Sawtelle, Calif., was listed as 6QJ thru an error, his call being 6TQ. Some stations were not heard at all, probably because their *sigs.* were not leaving their spark gap, and there appears to be a heap of them around the country just like this. Some stations, like 7YS, 7ZS, and a few others, are hundreds of miles away from any one, and the fact that they were heard shows that they actually do work remarkable distances.

One good thing about these relays is that we are interesting the amateurs in the south and west where good stations are needed in the event of war. Publicity relays are the only kind of relays that are going to be any good to you, until you all are officially recognized by the Government as a factor in its Third Line of Defense.

Robert Higgy, late of the Lima High School, Ohio, was at his new home in Phoenix, Arizona, with the receivers strapt on as usual. He caught the MSG from 5DU and also heard 9NN talking about it with 5DU. This is the kind of sending that you boys want to do, and don't let anyone tell you that this is freak work.

For instance, station 8NH received 6 credits for checking six stations, as did also 9MK, and all of these will count in the final round-up to award the prize to the best all around station for sending and receiving.

The next relay will be something entirely new and novel, and as the moss-grown elders would say, "A Publicity Relay."

The Prize Winners.

8YZ, Peabody High School, of Pittsburg, Pa., is awarded the second prize of *One Tubular Audion Panel, Assembled,* with two filament bulb, rheostat, and ready to be connected up for use, for obtaining 1,893 signatures of American citizens. This panel has been most graciously donated by the National Electric Mfg. Co., Mallers Bldg., Chicago, Ill.

2AGJ, J. K. Hewitt, of Albany, N.Y., turned in 861 signatures and receives the 3,000 ohm pair of 'phones of the remarkable 55 type, unconditionally donated by the Wm. B. Murdock Co., of Chelsea, Mass. This is the third prize.

The Ames Radio Club of Ames, Iowa, turned in 777 signatures, and evidently had a lucky combination of figures; anyway they are awarded the fourth prize—a pair of 2,000 ohm 'phones donated by the Wm. B. Murdock Co., of Chelsea, Mass. This is the new club just formed of some very progressive amateurs, and you will hear more from them later.

9HQ, Owen R. Terry, Stoughton, Wisconsin, receives the fifth prize for turning in 716 signatures to the MSG. This will be one two-filament tested Electron Relay, donated by the Pacific Research Laboratories of San Francisco, Cal. This company would not consider any other arrangement but that the writer permit them to give ten of these prizes to the lucky winners.

The following will get an Electron Relay from the above company:

J. I. Greene, Rock Falls, Ill., 714 sigs. A newcomer in the game.

9RD, F. M. Bailey, Clinton, Iowa, 554 sigs. An old war-horse, with a son 21 years old.

9NY, R. O. Strock, Polo, Ill., 502 sigs. An ardent worker. Watch him for results.

Glenn Fordyce, Anita, Iowa, 338 sigs. This little fellow is a "newsie."

91K, R. W. G. Mathews, Chicago, Ill., 315 sigs. A pleasant fellow, hard worker and A No. 1 amateur.

9ACM, A. E. Jeffrey, High School, Goshen, Ind., 281 sigs. A busy school teacher who finds time for a little recreation that also interests his pupils.

1IZ, Robert T. St. James, Great Barrington, Mass., 279 sigs. A bright star in the east.

(*Continued on page 682*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

H. Gernsback, Manager

New Wireless Law Planned

Members of the Radio League of America as well as all others interested in Radio telegraphy and telephony, will note that a new Wireless Law has been proposed, to supersede the Radio Law of August 13, 1912.

Before we go any further, we call to the attention of all concerned that the new Act, providing it will be past, will not in any way be detrimental to radio interests. Quite the contrary, due consideration has been given to amateurs as will be seen by perusing the draft of the proposed Law.

We have printed below the letter of the Radio League of America to Mr. D. W. Todd, in response to his letter of November eleventh, and it will be seen that we recommend that radio amateurs owning receiving stations only should be included in the new Wireless Law, the recommendation being that such stations should not be required to be licensed, but that they should be subject to the section 15B, which calls for secrecy of all messages received and a penalty for divulging the contents of any message.

By reading the proposed draft carefully, it will be noted that, as far as the amateur is concerned, it is identical with the present law. So amateurs need not have any misgivings, at least for the present.

The proposed new Radio Law has been primarily originated to keep foreign governments from planting wireless stations in the United States which could be used to violate our neutrality in times of peace, when foreign Governments are at war. No patriotic American can fail to endorse the new bill on account of this.

Radio amateurs may rest assured that the Radio League of America will see to it that amateurs will get due consideration and that nothing detrimental shall be undertaken against them without all being informed before any new Law should go into effect.

MR. TODD'S LETTER.

Address:
Chairman, Inter-Departmental
Committee on Radio Legislation,
Room 273, Navy Department,
Washington, D.C.

INTER-DEPARTMENTAL COMMITTEE ON RADIO LEGISLATION
Washington, D.C.,
November 11, 1916.

RADIO LEAGUE OF AMERICA,
233 Fulton Street,
New York City.

Gentlemen:

An inter-departmental committee appointed to consider suggested changes and amendments to the so-called Radio Act of August 13, 1912, has prepared the inclosed draft of a bill which it is proposed to have introduced at the next session of Congress as a substitute for the present Radio Act mentioned above.

A copy of the draft prepared is inclosed herewith for your information. The Committee desires to meet interested parties informally to get the benefit of such comments and recommendations as they may choose to make, at 10 a.m., Tuesday, November 21, 1916, in Room 1023-A, Department of Commerce, 19th Street and Pennsylvania Avenue, Washington, D.C. Should you not wish to be represented at the meeting, the Committee would be glad to receive your written comments and suggestions.

Please acknowledge receipt, and state whether or not you will be represented, and, if so, by whom.

Respectfully,
(Signed) D. W. TODD,
Commander, U.S. Navy,
Chairman.

REPLY OF RADIO LEAGUE OF AMERICA.

THE RADIO LEAGUE OF AMERICA.
233 Fulton Street,
New York, Nov. 18, 1916.

D. W. Todd, Esq.,
Commander, U.S. Navy,
Chairman, Inter-Departmental
Committee on Radio Legislation,
Room 273, Navy, Dept.,
Washington, D.C.

My dear Sir:

Thank you for your letter of November 11th, enclosing draft of a new bill which is to be introduced at the next session of Congress, this proposed bill to supplant the Radio Act of August 13th, 1912.

As Manager of the Radio League of America, I represent directly the largest body of radio amateurs in this country and as such, the recommendations I shall make below, naturally concern only the vital interest of the radio amateurs of this country.

The fact is probably known to you that the writer who was the founder of the now defunct "Wireless Association of America" has always striven, not only to protect the radio amateurs' rights, but also to see to it that Government and Commercial stations should not be interfered with by irresponsible amateurs. Before 1912 amateurs continually interfered, today such interference is practically unknown.

As is probably known to you, the writer is responsible for the idea of restricting amateurs to a 200 meter wave length, as well as restricting them to the use of no larger input than 1 k.w. The writer's recommendation first published in his editorial in the February 1912 issue of *Modern Electrics* was subsequently embodied in the Radio Act of 1912, and as far as the writer is aware of, the idea has proved eminently satisfactory to all concerned.

Before proceeding, allow me to place before the Commission several relevant facts, not apparent at first glance.

Radio amateurs of today may be broadly classed in two groups:

1° Those who own transmitting and receiving apparatus.

2° Those owning only receiving apparatus.

Group one was thoroly covered by the 1912 Radio Act, while the Act said nothing about group two.

This is as it should be for the Radio Amateurs owning receiving stations only—and they total probably over 90% of all amateurs—can hardly ever cause mischief. For, if the message is of an important nature, it is usually sent in code, therefore unintelligible to the amateur. Un-coded messages, as far as their secrecy is concerned, are covered by the Radio Act, section 19, which makes the unauthorized divulgance of any message punishable by a fine.

But since the Radio Act of 1912 a new condition has arisen, namely Radio Time service. At present when several of the powerful Government stations are sending out time signals at noon and at 10 p.m., as well as sending out weather reports, thousands of "amateurs" who are jewelers and the like, depend directly upon their radio outfits for this important service.

For this and other apparent reasons, I recommend that the new Act should contain the following addition. It could be added to Section 18 of the proposed Act, as follows: (The capitalized sentence showing the proposed addition.)

Sec. 18. General amateur stations shall not use a transmitting wave length exceeding 200 meters or a transformer input exceeding one kilowatt.

NOTHING IN THIS ACT SHALL BE CONSTRUED TO APPLY TO THE RECEPTION OF RADIOGRAMS, RADIOPHONE MESSAGES OR RADIO TIME SIGNALS BY AMATEURS OPERATING RECEIVING APPARATUS ONLY. SUCH STATIONS ARE NOT REQUIRED TO BE LICENSED BUT THEY ARE SUBJECT TO THE REGULATIONS UNDER SECTION 15 (b).

Under the proposed Sec. 9 No. 4, the writer would recommend the following addition: (Capitalized.)

4. Apparatus other than that specified in the license shall not be used for radio communication, **EXCEPTING AMATEUR STATIONS. SUCH STATIONS ARE PERMITTED TO CHANGE THEIR APPARATUS, IF IN THE DISCRETION OF THE DISTRICT RADIO INSPECTOR, SUCH CHANGES ARE CONSIDERED REASONABLE.**

No further recommendations or suggestions can be made by the writer, but he takes this occasion to congratulate the committee on the patriotic changes embodied in the proposed Radio Act. It will certainly be a big step towards upholding the neutrality of the United States when foreign nations make war upon each other. We seem to have profited by our disagreeable experiences of 1915.

Thanking you in advance for keeping the writer informed of the progress of the new bill, he remains,

Yours very respectfully,
RADIO LEAGUE OF AMERICA,
(Signed) H. GERNSBACK.
Manager.

PROPOSED NEW RADIO LAW.

AN ACT TO REGULATE RADIO COMMUNICATION.

Sec. 1. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That wherever used in this Act the term "radio communication" shall be construed to mean communication by any system or method of electrical communication without the aid of wire or other conducting connection; the word "apparatus" to mean machines, devices, and all other equipment used in radio com-

(*Continued on page 671*)

Election Returns Flashed by Radio to 7,000 Amateurs

SEVEN thousand wireless telephone operators within a radius of 200 miles of New York City received election returns from the *New York American*. Three hundred and fifty moving-picture theaters; special bulletin boards in different parts of the city, and the principal hotels of Manhattan obtained the news from the above office, as fast as it was received. Fifty extra telephone lines were run into the *American* office, the theaters were placed on lines that were in continuous operation, and while the news of the closest Presidential election in years was being given to the public thru these channels, the editorial staff compiled the returns without the slightest confusion.

How the "Election Returns" Gathered by the "New York American" Were Spread Broadcast to 7,000 Waiting Amateurs by Wireless Telephone from the de Forest Laboratory Near New York.

When the returns came in, indicating the election of Hughes, and the first edition was prepared for press at 11 p.m., the heads and the reading matter inclined that way. Later there was a change, a doubt was cast, and then the tide drifted Wilsonward. It ebbed and flowed, from one candidate to the other, for several hours. Thru the clearing house all outlying district information was gathered, in an effort to sweep aside the uncertainty. Then the headings, which were studies in clarity and terseness, were altered, the introductions and summaries were changed, and Wilson was featured as the winner. The wireless-telephony feature was remarkable. The 7,000 amateur radio operators were all notified in advance, and the news was supplied in the most systematic manner, thru the circulation department, by an expert from the editorial rooms, who took his bulletins from the same source as the fifty operators who supplied the moving-picture shows, hotels, and bulletin-board operators.

Realizing that all men cannot grasp a spoken message alike, or in the same time, and because it was impossible to stop and answer questions, a black-board was erected, in view of all the operators. The bulletins were written on this and reading from it, the operators telephoned the news to the different points. In the picture theaters the messages were transmitted to slides and flashed on the screen.

The amateur wireless operators located in different towns about New York gave out the information, and allowed others to *listen in*. They heard not only election returns, but music as well.

Over their heads, reaching from that droning desk in the *New York American's* office to the white bulletin boards on which their eyes were fastened, a vast network of electrical waves were meshing and passing. On these unseen waves the news they sought was carried.

From the deep semi-circular desk the news had been flung by telephone to the de Forest Wireless Telephone Laboratories at Highbridge on the Harlem River. Up in the de Forest tower sat Walter Schare, an unassuming chap, who listened thru a receiver clamped to his ear.

At Schare's hand was the wireless telephone transmitter switch. As he heard the news from the seventh floor of the great red building near Brooklyn Bridge he snapt it forth to 7,000 anxious amateur wireless operators within that great 400-mile circle.

Between the bulletins, music was sent thru the clouds. The crowds heard "The Star Spangled Banner," "Dixie," "Columbia, the Gem of the Ocean," "America," "Maryland," "Yankee Doodle" and all the other anthems, songs and hymns that Americans love.

The radiophone equipment consists of two large Oscillion tubes, used as the generators of the high frequency current, which may be seen on the panel. They develop one-half kilowatt of energy and this charges the antenna. The high potential current is obtained from a 1500-volt direct current generator, driven by a constant speed motor. This high tension current is controlled by suitable rheostats and shunted with capacities so as to reduce the inductive reactance as much as possible in the oscillating current. The filaments are lighted by 110 volt direct current. The oscillating circuit comprises a number of capacities and inductances properly balanced in the circuit. The voice-current modulations are derived from a microphone, inductively coupled to the high frequency circuit. Another microphone connected in parallel with the first by a switch, is used in conjunction with a phonograph. The operator standing near the microphone is Charles Logwood, chief engineer to Dr. de Forest, and a great deal of credit is due him in the development of the radiophone employing the Oscillion tube as a generator of radio frequency currents.

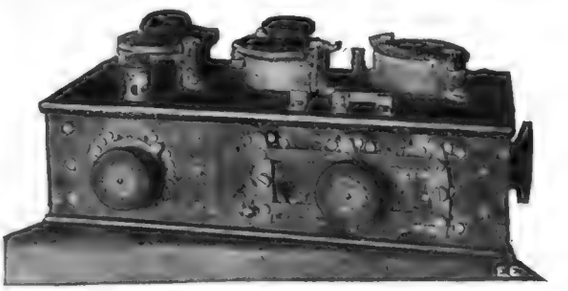
Dr. Lee de Forest gave a demonstration of transmitting music by wireless at the Hotel Astor, New York, on the evening of October twenty-sixth. Columbia phonograph records played from the laboratory of the company at 102 West Thirty-eighth Street were distinctly heard in the receiving room of the Astor, with the exception of a few interruptions by the powerful naval wireless apparatus at the Brooklyn Navy Yard, when the warning of a storm was heard intermittently with the music.

The U.S. Radio Bureau has been informed that the following land stations in Alaska have been closed for the season, and will not be reopened until March, 1917: Akutan (KNW), Chignik (KHC), Egegak (KMF), Hales Creek (KMT), Koggiung (KVV), Koggiung (KHB), Nahnek (KHT), Naknek (KMK), Nushagak (KMG), and Snag Point (KHF).

A WIRELESS TUNER OF MANY WAVES.

The accompanying photograph shows the multiple radio tuner (a portion of the wireless receiving apparatus) of the ill-fated steamship *Falaba*, after lying on the bed of the ocean from the third of March until the twenty-ninth of October, 1915.

On the latter date it was pickt up in a trawl and delivered to the Receiver of Wrecks at Milford Haven, subsequently being forwarded to the London Office of the Marconi Wireless Telegraph Company. It has suffered surprisingly little considering the vicissitudes thru which it past.



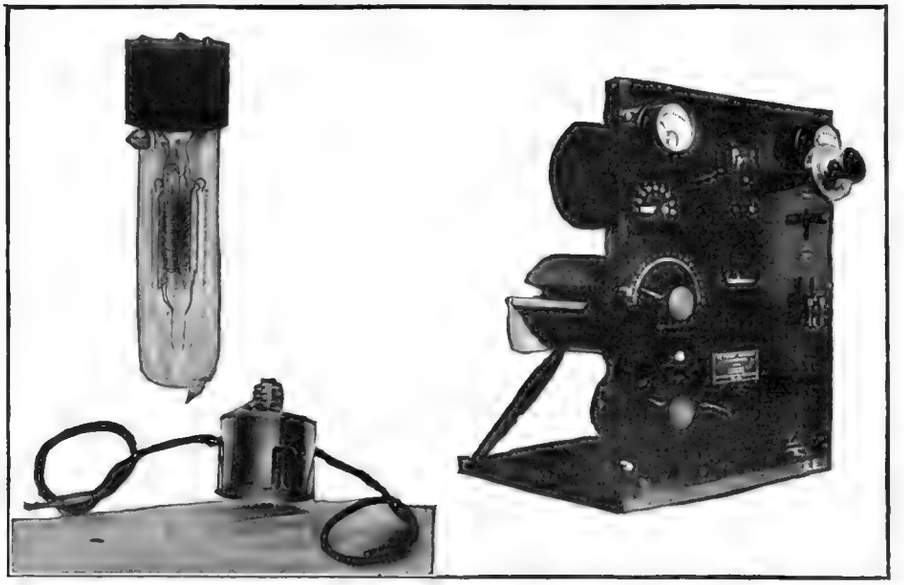
Appearance of Radio Tuner from Ill-fated Steamship "Falaba," After It Had Lain on Bed of the Ocean for Eight Months.

NEW AUDION AND RADIOPHONE APPARATUS.

We herewith present two of the latest radiophone apparatus. The outfit on the right is a complete 250 watt radiophone transmitter of recent design which has a working range of thirty to fifty miles. The high frequency generator consists of a special Oscillion bulb, which is located behind the panel. The filament current is obtained from either a storage battery or directly from a 110 volt direct current line. This current is controlled by means of a suitable variable resistance, which is located on the lower left hand corner of the panel. The current consumed by the Oscillion filament is indicated on the ammeter shown.

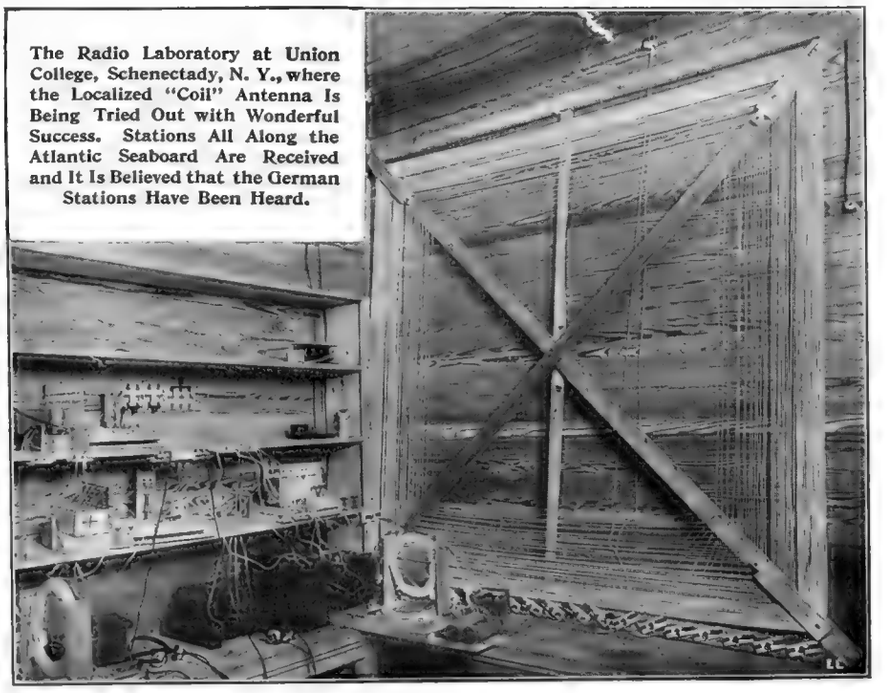
The oscillating current generated by the Oscillion is controlled by means of a large capacity consisting of a large variable condenser, the handle of this being visible at the left center of the panel. A portion of the stationary and movable plates are seen. The inductance, which is properly linked with the capacity, is wound on an insulating form and its turns are varied by the multi-point switch just below the ammeter. The aerial current is modulated by means of a special microphone mounted on a standard type of telephone bracket. The antenna radiation current is indicated by a hot wire ammeter, which is placed on the upper right hand corner of the panel. Two switches are secured to the right of the panel, one being employed for throwing in the current to the filament, while the upper one connects the outfit to the aerial. A rectangular opening is provided in the center of the panel for indicating whether the Oscillion filament is burning.

Dr. de Forest has lately turned his attention to developing a more sensitive type Audion bulb, which will give better service and at the same time have a greater operating life. This new bulb is illustrated at the left. It is similar in general to the older Audion, inasmuch as it employs a filament, grid and wing. The only difference between the newer one and the old type is that it makes use of a spiral filament, while the grid is composed of many turns of fine tungsten wire wound about a glass frame as shown. This grid is placed between two flat tungsten electrodes, which constitute the wing of the Audion. The exhaustion of the tube is far greater than usual, thus increasing the life of the filament; as a matter of fact, it was shown in actual tests that the filament can stand up for 5,000 hours, which is exceedingly long as compared with the standard Audion filament.



Improved Form of Audion Designed by de Forest (Left). Illustration at Right Represents New Compact Wireless Telephone Set for Talking Over 30 to 50 Mile Range with 250 Watt Oscillion Bulb.

Another feature of this type of Audion is in the manner in which its parts make electrical connection with the auxiliary instruments. An insulating cap is provided upon which three contacts are placed, each of which are connected to the individual parts of the Audion. Upon this rubber cap a special metallic cover is placed, seen at the bottom of the photo. This is fitted with a standard lamp base which connects the filament with the current supply while the two flexible conductors are used for connecting the grid and wing of the Audion. This type of Audion has proven very successful.



The Radio Laboratory at Union College, Schenectady, N. Y., where the Localized "Coil" Antenna Is Being Tried Out with Wonderful Success. Stations All Along the Atlantic Seaboard Are Received and It Is Believed that the German Stations Have Been Heard.

LONG DISTANCE RADIO WITHOUT AERIALS.

Many operators of wireless apparatus probably noticed at some time or other, that signals could be received even though the antenna were disconnected. An observation of this kind led to the work which is now being carried on in the new wireless laboratory at Union College.

The fact seemed interesting and important, it opened up the possibility of receiving signals without the necessity of installing an expensive receiving antenna and an elaborate receiving outfit. Work was, therefore, started along scientific lines to determine the best construction of a wire coil which would receive such signals. It was evident at first that a large coil would be better than a small one. It seemed also reasonable that sharper tuning could be possible with a coil of low resistance than with one of high resistance, and finally that a coil having the least distributed capacity for a given inductance would be best.

Based upon these assumptions several rectangular coils of approximately 100 turns of No. 18 stranded conductor, having from 4½ to 6½′ on a side, have been made and tried. These permit of various groupings of wires in order to study all factors entering in the problem.

So far the work has proven very encouraging and signals from the large transcontinental and trans-Atlantic stations have been received with the greatest ease, under the most adverse atmospheric conditions. While we have not positive evidence, say those in charge, the indications are strong that some of the foreign radio stations have also been received. Arlington time signals have been received very satisfactorily.

Wireless telephony over a moderate distance has been tried successfully. In this work advantage has been taken of the best known methods of detecting and amplifying the signals. Oscillation sets having Pliotrons and Audions are used and the waves of audible frequency have been amplified in successive steps.

It would seem a good idea for the wide-awake radio experimenter to thoroly try out localized antennae. Such aerials possess many highly desirable features.

Radio Detector Development

By H. Winfield Secor, A.I.R.E.

WHILE wireless telegraphy is a far cry from the philosophy and traditions of the Hindoos, it may not be inopportune to cite, for purposes of comparison, an ancient tradition of the Hindoo priests which brings out in a marked and comprehensible manner the gigantic loss existing in wireless telegraphic transmission, with especial regard to the infinitesimal amount of energy that is received at the wireless receiving station with which to actuate the detector.

The Hindoos, with all their profound philosophical deductions, were never able to figure out the age of the earth any more definitely than our geologists and scientists have to-day. But they did have a very good example by which to give a practical idea as to this vast stretch of time. Said they:

Let us suppose that we have a marble cube 1 mile high—1 mile wide—and 1 mile long. Suppose, also, that a lady wearing a shawl visits this marble cube once in every hundred years (presumably not the same lady), and that she brushes the marble once with her shawl. In time, of course, the marble will be worn down to the size of a pea, and he who can figure out the length of time in years required for this to be accomplisht, would know the age of the earth. And the Hindoos called this period of time one Marcalper, and the actual age of our planet as one Marcalper times one Marcalper.

This is a homely little story which may help by comparison to instil in the lay mind something of the enormous loss of energy which takes place in the transmission of Radio signals over great distances.

We will not deal exhaustively, or even attempt to, in the present discussion, on the efficiency of wireless transmission for any given condition or set of conditions, but an example of the amount of energy utilized at a typical trans-oceanic or trans-continental radio station and that arriving at the receiving station may be illuminating.

We may easily assume that the amount of power radiated at a transmitting station for a 3,000 or 4,000 mile range is 50 K.W. or 50,000 watts. Bearing in mind that a watt is equal to 1 volt times 1 ampere, and that it is considered excellent when 20 micro-amperes or about .01 microwatt is registered at the receiving station with which to actuate the detector, then we have some idea as to how all-important the radio detector is and we have an analogy to a degree, with the Hindoo philosophy cited above. With 50 K.W. used at the radio transmitter and but .01 microwatt received, we find that this is but one *five-trillionth* (1/5,000,000,000,000th) of the energy sent out. Before leaving this point it is well to mention that 10 micro-amperes (1 micro-ampere is equal to one one-millionth of an ampere), is considered a weak signal and 20 micro-amperes received current a strong signal.

Technically speaking, radio detectors are usually rated by the amount of electrical energy in *ergs* necessary to actuate them.

One of the first, and, so far as we know, really the first wireless detector which would manifest and interpret the electromagnetic waves sent thru the ether by a spark discharge such as that from a static machine or induction coil, is the *Hertz Micrometer Spark Gap* or *Resonator,* shown at Fig. 1.

This comprised simply an insulated handle on which was mounted a flexible metal loop and the abutting ends of which carried spark points or balls, which could be separated or brought very close together by a fine micrometer screw attachment as shown. For short distances such as in laboratory tests over a few hundred feet, the spark gap resonator proved successful and showed Heinrich Hertz the way to his important deductions on which is based to a very large extent the wireless telegraph that we know today. The gap is regulated when in use until tiny sparks are seen to pass between the points every time the transmitting key is deprest.

Next we come to the *Filings Coherer* as used by Guglielmo Marconi in the first commercial radio sets which he built and installed on a number of vessels. The coherer is shown at Fig. 2 with its magnetic tapper, resembling a vibrating type electric bell, which, having its circuit closed by the relay connected with the coherer, served to shake the glass coherer tube and the metal filings within it and to decohere the filings or shake them apart. The coherer was then ready for the next signal.

The metal filings of certain and exact proportions as found by lengthy experiments (after the method of Professor E. Branly of France) are placed within the evacuated glass tube as shown. This is carried on an ivory rod. Normally, and before the arrival of a wireless impulse from the transmitting station, the filings lie loosely in the tube and the resistance of the coherer is very high, causing the relay to remain neutral. When a wireless signal arrives, the current induced in the antenna passes thru the coherer to earth and causes the minute metal filings (usually a mixture of nickel and silver) to "cohere" or stick together. This has the effect of lowering the resistance of the coherer quite markedly and permits sufficient battery current to pass thru it and thus close the relay armature.

Simultaneously the decoherer or tapper circuit is closed and in the final radio receiving sets of this type developed by Marconi a Morse tape recorder was also connected in the circuit, upon which the incoming dots and dashes were recorded and the operator could then decipher them at leisure. Moreover, there was a permanent record of every message received in this case, which is often of paramount importance, especially in military and naval work. The coherer, however, had several defects in that it was not very sensitive and was difficult to adjust. It often lost its adjustment, in many instances, a minute or two after it had been regulated or set.

Referring to Fig. 3, we have what is known as the *Auto-Coherer.* Several types of this detector have been evolved, but are practically extinct nowadays, owing to lack of sensitivity and other untoward features. One of the principal auto coherers developed was that known as the *Castelli* coherer and is said to have been used at one time by the Italian navy. It employed one or more globules of mercury within a glass tube, this globule (of 1.5 to 3 m.m. diameter) being placed between iron and (polisht surface) carbon electrodes, preferably, as shown in the illustration. A modification of this arrangement, first used by Mr. H. Gernsback, involved the substitution of polisht carbon granules between an iron and carbon electrode. These detectors were used with a telephone receiver and battery (one dry cell). They possess the faculty of establishing decoherence automatically, and thus are always ready to receive the next signal upon the cessation of the previous one. Their resistance falls upon receipt of a signal.

The detector illustrated at Fig. 4 is the well-known Rutherford-Marconi *Magnetic Detector.* This instrument operates on a very unique principle, viz., that of the reduction in any hysteresis effect occurring in an iron core, when this core is subjected to the effect of a Hertzian wave current passing thru the receiving circuit, according to the researches of C. Maurain. The complete detector is so arranged that a band of fine insulated iron wires constantly revolve about two rotary drums, driven by a spring or electric motor, and a pronounced hysteresis or magnetic frictional effect is produced in that section of the traveling iron wire band directly under the poles of a set of steel magnets mounted as shown. At this point there is also placed a small transformer containing a primary and secondary coil. Thru the primary coil is past the aerial current induced by the incoming electro-magnetic wave, while to the secondary coil is connected a pair of low resistance telephone receivers.

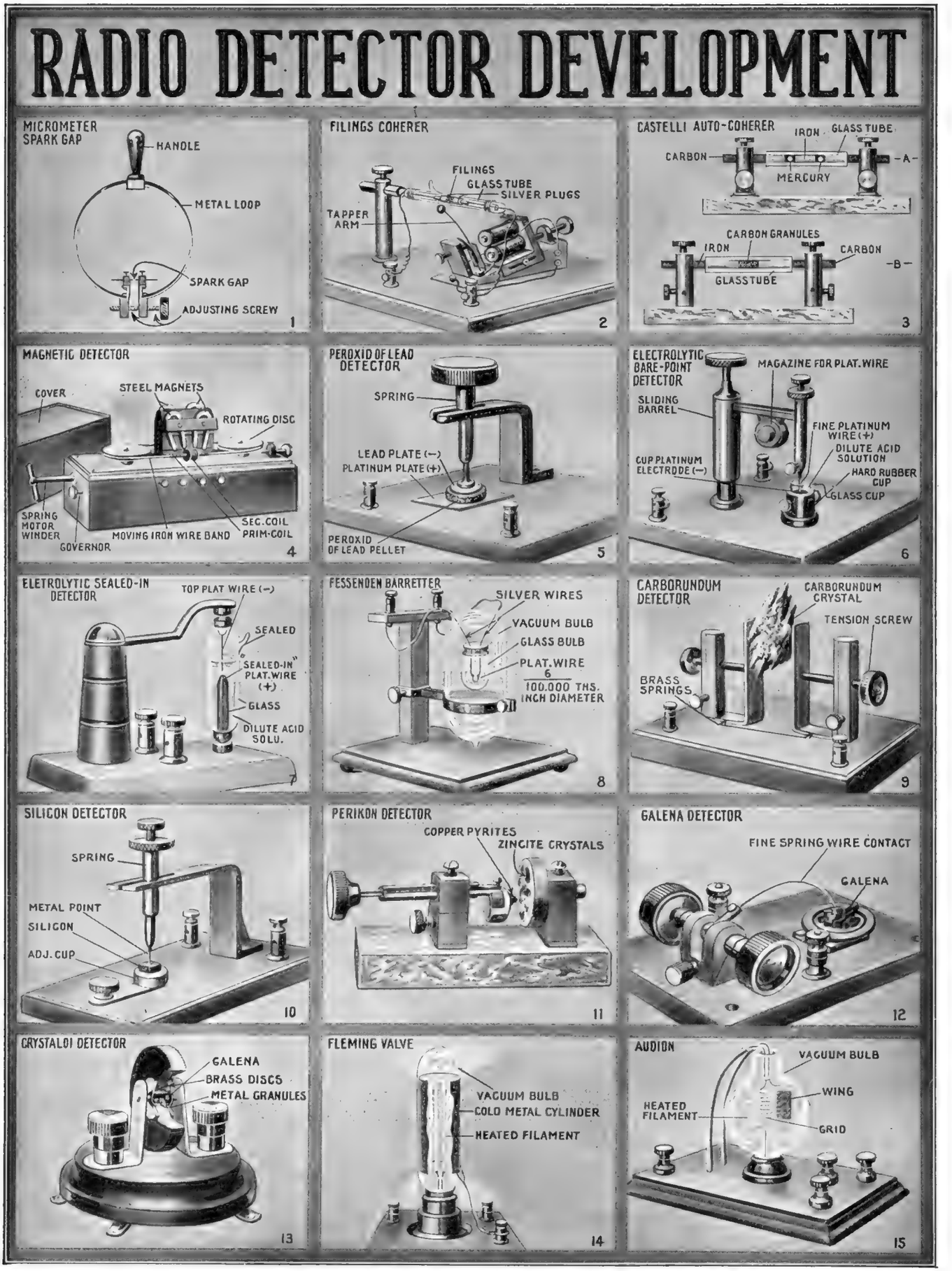
It is evident, from the foregoing explanation, that at every incoming signal there will be a sound heard in the 'phones as the Hertzian wave currents flowing around the primary coil cause partial cessations or reductions in the hysteresis effect produced in the moving iron wire band.

The *Peroxid of Lead* detector devised by S. G. Brown of England is illustrated at Fig. 5. This detector has proven quite successful and is used with a pair of sensitive telephone receivers and a critically adjusted battery current. The instrument comprises a peroxid of lead pellet mounted between an upper *lead* disk and a lower *platinum* one; the pressure on the peroxid of lead pellet being adjustable by means of a thumb screw and spring in the usual fashion. This detector has been termed, more or less correctly, the *dry* electrolytic detector and its action is supposed to depend upon the fact that an incoming oscillation intensifies the counter-electromotive force set up by the cell (electro-chemical action due to lead-peroxid lead-platinum couple) and which opposes the applied battery current (1.5 volts about), thus causing the detector to increase its effective resistance. This results in a drop of current in the 'phone circuit; as soon as the oscillation ceases the 'phone current increases.

The *Bare-Point Electrolytic Detector* illustrated at Fig. 6 has been the subject of much discussion among radio men as to who really was the basic inventor of it. But most writers of the day give credit, jointly, to Dr. Michael I. Pupin (1899), Professor Reginald A. Fessenden (1903) and W. Schloemilch (1903).

The action of this detector is based upon the fact that if an extremely fine platinum wire, measuring a few ten-thousandths of an inch in diameter is allowed to partially immerse its extremity in an acid solution (such as one composed of five parts water and one part nitric acid) that an incoming Hertzian wave current will tend to arrest the strong polarization (the production of fine gas bubbles) set up about the fine platinum wire, which is usually made the anode in the battery circuit. Further, the electrolytic detector has been found by Professor G. W. Pierce to act as a rectifier and that the inherent action is also based on polarization capacity at the electrodes as first described by Pupin in 1899. Dr. L. W. Austin and others have found that the fine platinum wire may be positive or negative for feeble oscillations with equal results. The acid solution is contained in a glass or carbon or zinc cup as shown, and this acts as the cathode in the battery circuit. This detector possesses the function of acting as

(*Continued on page 680*)



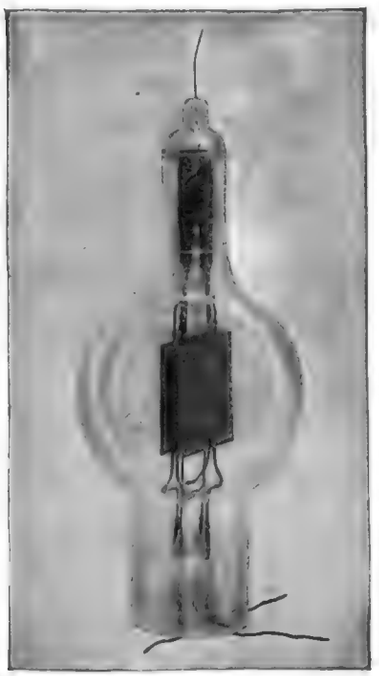
(For full description see opposite page.)

PLIOTRON OSCILLATOR.

By Dr. William C. White

In the present article the use of the pliotron for the production of alternating currents is described. The pliotron (see illustration) has three elements, filament, grid, and plate, all inclosed in a highly evacuated globe. The tungsten filament is about 10 inches long and W-shaped, the four spans lying in the same plane. The grid surrounds the filament, and consists of a mesh of very small tungsten wires lying in two planes, one on each side of, and parallel to, the plane of the filament. This is made by winding the tungsten wire for the grid on a rectangular frame. The planes of the grid wires are each about ⅛ inch distant from the plane of the filament. The plate consists of two rectangular sheets of thin tungsten about 1.75 inches by 2.5 inches and these sheets are spaced parallel to each other about 0.5 inch apart; these are held in the bulb so as to be parallel to the planes of the grid and filament and, therefore, each one is spaced about 0.25 inch from the filament.

These pliotron tubes are evacuated to a high degree and the metal of the grid and



The "Pliotron" Oscillator Bulb as Developed by the General Electric Company's Physicists.

the plate is freed from occluded gases. In operation the filament is made incandescent as in a lamp, and if then a positive potential, with respect to the filament, is applied to the anode a current will flow between the two, due to the passage of electrons from the filament to the plate. Providing the filament is emitting sufficient electrons, the number of electrons reaching the plate per unit of time (and thus the current between filament and plate) depends upon the potential gradient, and, therefore, this current increases with the plate voltage. Again, the electrons in their passage must pass thru the mesh of the grid. Any change in potential of the grid with respect to the filament changes the electric force distribution, the electron current. If the grid is made positive with respect to the filament the electrons are accelerated and the current increases; if negative, their acceleration is retarded and the current decreases. (*For explanation of this phenomenon see the August, 1916, issue of* THE ELECTRICAL EXPERIMENTER,

(*Continued on page 671*)

Action of Detectors in Wireless Telegraphy*

By Wilder D. Bancroft, (Cornell University)

PROF. G. W. PIERCE classifies the detectors used in wireless telegraphy under the following heads: electrolytic detectors, crystal rectifiers, coherers, magnetic detectors, thermal detectors and vacuum detectors.

This article deals with the first three cases, beginning with the electrolytic detector.

"The electrolytic detector for electric waves, as described by Fessenden and shortly after by Schloemilch, consists of a cell containing an electrolyte and having one electrode of very small area, usually in the form of an extremely fine wire of platinum, and as the other electrode a larger area of platinum or some other metal. When used in wireless telegraphy the two electrodes are connected in a circuit upon which the electric oscillations are imprest, so that the rapidly oscillating electric currents in the circuit are made to traverse the cell of the detector. The electrolyte employed in the electrolytic detector is usually 20 per cent. nitric acid, though almost any electrolytically conductive liquid (dilute sulfuric acid, common salt solution, caustic soda, etc.) may be used. For a highly sensitive detector the fine platinum wire employed as the sensitive point may be as small as one or two ten-thousandths of an inch (0.0025-0.0050 mm.) in diameter. For a less sensitive detector, which is not so likely to be destroyed by strong signals, wire as large as one-thousandth of an inch (0.025 mm.) or even larger may be used."

The usual way is to polarize the detector cell by means of an external circuit. When the electrical waves strike the detector a current passes. This is a case of depolarization by electrical waves, which tend to remove the *absorbed* gas from the surface of the electrode, thus cutting down the over-voltage and the polarization.

According to Pierce, molybdenite, MoS_2, is one of the most sensitive of the crystal rectifiers thus far investigated. This is especially interesting because the experiments on ore flotation show that the sulfide ores have a marked tendency to absorb gases. According to Wood, molybdenite ores are now being concentrated by flotation.

Carborundum crystals show unilateral conductivity, since "the current through the crystal in one direction under a given electromotive force was found to be different from the current in the opposite direction under the same electromotive force." In terms of our hypothesis this means that the thickness of the absorbed gas film is decreased more when the crystal is charged positively than when charged negatively, or *vice versa*. This is not without analogy. Twomey has shown that chloroform absorbs air less readily in alkaline solutions where the chloroform is charged negatively by absorbed hydroxyl ions that in acid solutions where the chloroform is charged positively by absorbed hydrogen ions. I cannot agree entirely that "when suitable crystals are employed, the crystal contacts are *detectors* for electric waves because they are *rectifiers* for rapid alternating currents." It is quite true that the crystals must conduct unilaterally if they are to be used as detectors without a battery in the local circuit; but this requirement is not necessary if a battery is used.

Since the action of the crystal detectors merely involves the temporary decrease in the thickness of the absorbed gas film, it is not surprising that carborundum crystals should show little or no change with time when used as detectors or rectifiers.

*Paper presented before the American Electrochemical Society.

In confirmation of the absence of electrolytic polarization, a durability test of the carborundum rectifier has been made as follows: A crystal of carborundum enclosed in a glass tube with a few drops of oil and held between brass electrodes, one of which was pressed forward by a spiral spring, was kept under almost daily observation from October 23, 1907, until March 18, 1908. During these five months more than 1,200 measurements were made of the direct current obtained through the crystal under different direct and alternating voltages. The rectifier was kept in a temperature bath and was subjected to various long periods of heating and cooling ranging from 0° to 80° C. Notwithstanding the long continued exposure of the crystal to large changes of temperature, and notwithstanding the frequent loading of the rectifier with current, it was found at the end of the series that the values of the direct current obtained from the crystal under a given applied alternating voltage over a range of current from 4 to 400 micro-amperes (direct) and a range of voltage between 1 and 6 volts (alternating) did not differ from the corresponding values at the beginning of the series by an amount exceeding the limit of accuracy of the experiment, which was about ⅓ of 1 per cent. This experiment shows that, if there is any kind of electrolytic action, it must be of such a character as to change the nature of the electrodes or of the crystal only very slowly, if at all.

This series of measurements was carried out by Mr. K. S. Johnson, to whom the writer wishes to express his sincere thanks. The experiment was finally discontinued on account of the accidental melting of the cement holding in the end of the tube.

While Pierce does not give the true theory of the electrolytic detector and the crystal detector, his conclusions in regard to the latter are interesting, especially in view of the fact that many people have believed that thermo-electric phenomena play an essential part. His conclusions follow:

1. An examination of the characteristics of contact detectors using carborundum, anatase, brookite, hessite, iron pyrites, and silicon shows that we are dealing with the same kind of a phenomenon in the case of all these crystal substances. The various other crystal-contact detectors which I have not examined probably act in the same way.

2. At the contact between the crystal and a common metal, or between two different crystals, or between two apparently similar crystals, there is asymmetric conductivity, permitting a much greater current to flow in one direction than in the other under the same applied voltage.

3. These contacts all have a rising current-voltage characteristic.

4. These crystals all have a large thermo-electric force against the common metals, and the amount and direction of the thermo-electric force is different at different points on the crystalline bodies.

5. The rectifying effect is also different in amount and direction at different points of the crystalline body; the direction of the rectifying effect is often opposite to the effect that would be obtained by heating the contact.

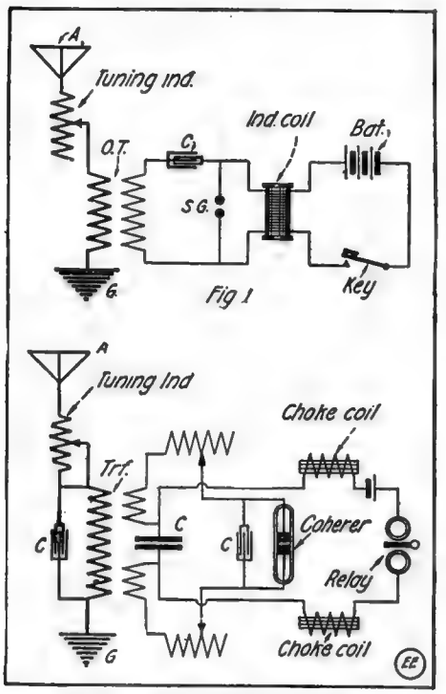
6. Thermo-electricity does not explain the phenomenon of rectification; but the two effects, since both exist in such marked degree in the same bodies, may be related in that both may have their seat in some common property of the materials employed. *For example, if we suppose that a surface of separation between the crystal-*

(*Continued on page 692*)

Marconi Company Sues the U. S. for $1,000,000 Damages

By A. Press, B.Sc.

THE Marconi Wireless Telegraph Company of America on July 19, filed in the Court of Claims, a petition against the United States, charging that since June 25, 1910, the United States, through the



Marconi's Patent No. 763772 (1904) Purports to Cover Selective Tuning in a Rather Monopolistic Manner.

Army and Navy departments, and the Department of Commerce, has constructed and used apparatus embodying the inventions covered by four certain patents in violation of the rights of the Marconi Company.

The patents in question are as follows:

Re-Issue No. 11913 (Original No. 586193, July 13, 1897), granted to G. Marconi on June 4, 1901, for transmitting electrical impulses and signals and apparatus therefor.

No. 609154, granted to O. J. Lodge on August 16, 1898, for inventions in electric telegraphy.

No. 763772, granted to G. Marconi on June 28, 1904, for apparatus for wireless telegraphy.

No. 803684, granted to J. A. Fleming on November 7, 1905, for instrument for converting alternating electrical currents into continuous currents.

The petitioner avers among other things that the United States, through its officers or officials of its Department of the Navy, its Department of War, its Department of Commerce, knowing that the validity of said letters patent had been adjudicated in favor of your petitioner by several of the courts of the United States, has, since the twenty-fifth day of June, 1910, and before the filing of this petition, made and constructed, and used, a very large amount of apparatus containing and embodying in use the inventions covered and claimed in and by said letters patent of the United States; entered into agreements with divers persons and corporations, among such persons and corporations being Fritz Lowenstein, Emil J. Simon, Telefunken Wireless Telegraph Company, Atlantic Communication Company, Kilbourne and Clark Company and Wireless Specialty Apparatus Company. The Marconi Company claims that this has resulted in great injury, damage and loss in the aggregate sum of $1,000,000.

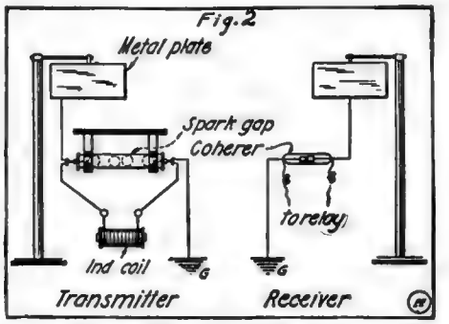
Turning to the particular patents in question it would appear that, the principal object of the Marconi invention cited in patent No. 763772 of 1904, appears to be to selectively syntonize a receiving station with a transmitting station. Strangely enough, one of the claims, claim 20, is of so indefinite a nature as to virtually control the broad idea of tuning a receiver circuit to be perfectly responsive to a transmitting circuit. It is a question whether a claim of such monopolistic scope can be maintained, because in the claim itself no particular means is set out whereby the well-known and desired object is to be attained.

From the fact that the patent discloses an adjustable reactance inserted in the antenna circuit, it follows that a certain degree of flexibility or adjustment is given to the system. The claims therefore are directed not only to the insertion of a reactance, whether variable or not, into the antenna circuit, but also to the possibility of attuning the practically closed oscillation circuit with the radiating or antenna circuit or with the transmission station. Their latter claims have certainly a much better chance of being maintained. The transmitter and receiving circuits are indicated at Fig. 1.

In the Marconi patent 11913, which is a reissue of the patent 586193 dated July 13, 1897, the invention goes back to the very early days when the earthed antenna terminal, both for sending and receiving was evolved. Acknowledgment is made of the work of Popoff in Russia, 1895-6, and of the writings of Sir Oliver J. Lodge in England, 1894.

In view of the disclaimer to claim 1, of the specification, it is difficult to see how claim 24 could be maintained, for in the text of the specification the making of the coherer tubes is acknowledged as well known and since reception of wireless waves by a filings coherer is also acknowledged to be old, a broad claim specifying nothing but the acknowledged elements of the art would seem to be in the same class with the disclaimed first claim which is of the same indefinite character.

The strong point about the above patent appears to be the reference to the earthed antenna circuit, though the claims are by no means as broad as would appear to be warranted. In the very early days of wireless the filing-tube-trembler element was

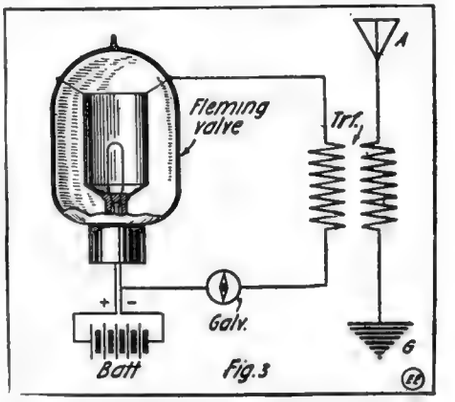


Marconi Patent No. 11913 (1901) Covers the Earth Connection and Other Features.

employed but this feature was soon discarded for other types of detectors. The appended Fig. 2 shows the essentials of the above features.

The Lodge patent 609154, dated August 16, 1898, seems to be directed particularly to the insertion of a variable reactance in the antenna circuit and also to the possibility of magnetically coupling the detector circuit to the antenna by means of a transformer.

Apparently the intention is to span the period from August 16, 1898, to date, by means of the patent as well as the later one issued to Marconi under No. 763772 as of date June 28, 1904. It is a little difficult to reconcile claim 7 of 763772 to Marconi with claim 1, for example, of 609154 of Lodge. Undoubtedly this matter would be taken up on its merits during the course of the suit, if it is the intention of the



The Famous Fleming Valve Patent, Which Appears to Cover Most Vacuum Tube Detectors of This General Type. See Recent Court Decision on This Patent, in the November Issue.

Marconi interests to sue on the basis of the above-referred-to claims.

With respect to the Fleming patent 803684 it is directed to the vacuum oscillation valve in which there is a rectification of current in precisely the same manner as in the important de Forest Audion valve. The fact that in any Audion type of valve three conductors are present or in fact necessary for current amplification, cannot, in any manner, affect the validity of the claims.

It is rather strange that the claims in the Fleming patent, in the broader aspect, should require that there should be present a circuit connecting the heated electrode with another electrode led in to the vacuum chamber. In so far as a receiving station is concerned, the patent is limited to means for detecting a continuous current in the circuit. When a transformer is incorporated into the circuit for the detection of current, the claims appear to fail in outlining the necessary protection. The subjoined illustration, Fig. 3, shows one form of the Fleming oscillation valve rectifier.

PROPOSED WIRELESS STATION FOR SPAIN.

According to information recently published in the official organ of the Seville Chamber of Commerce, a company has been organized with a view to operating wireless telephone systems in the different cities of Spain and to connect with the Spanish vessels and Spanish colonies in Africa. The proposal contemplates the erection of stations in the cities of Cordoba, Seville, Cadiz and Huelva, and 29 other stations in other parts of Spain, in the Canary Islands, and at Tangier, Melilla, Ceuta, and Ibiza, in Africa. The first-class stations are to be of 5 kw. and the second of 2 kw. rating.

DONE.

"Well," said the doctor, "you're cured at last. How do you feel?"

"I feel," said the "radio op," looking at his wallet sadly, "I feel as if I could start life all over again."

The How and Why of Radio Apparatus

NO. 2—THE TRANSFORMER.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations, that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the second paper is the TRANSFORMER.

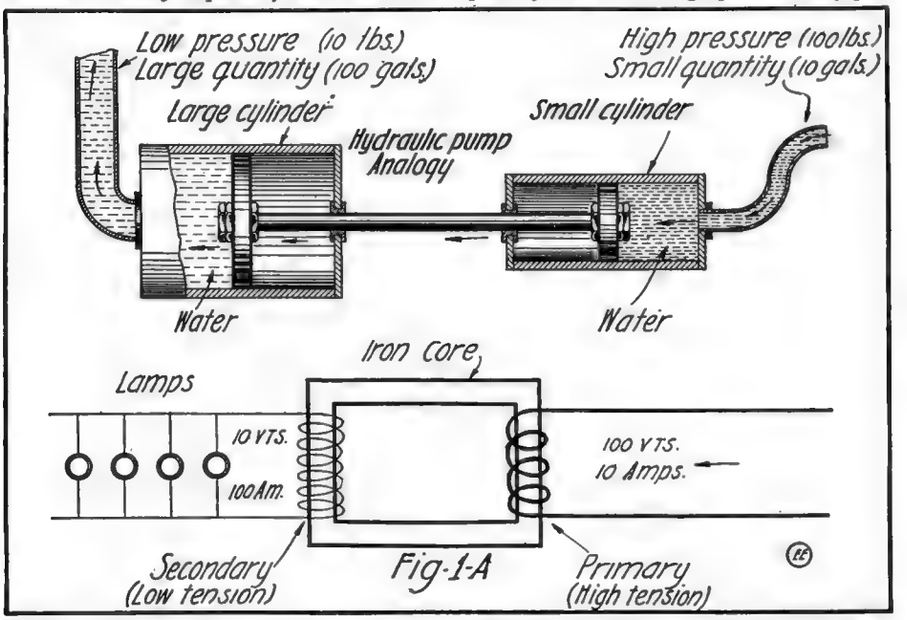


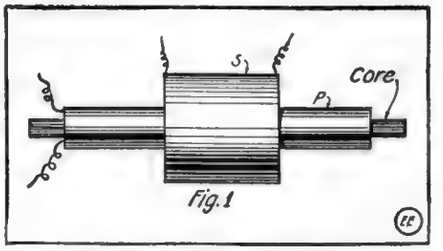
Fig. 1-A. Hydraulic Analogy of Transformer Action, Showing How Energy in One Form Can Be Changed Into Energy of Another Form.

THE first paper in this series dealt with the action taking place in the induction or spark coil as used for wireless and other purposes. In the present discussion we will consider the action occurring in that class of apparatus known as the alternating current *transformer.*

There are two distinct types of transformers, viz., the *open* and *closed core* type. The open or straight core transformer is shown schematically at Fig. 1 and the core consists of a laminated iron structure made of core wire or iron sheets, properly bound together with tape or placed in an insulating tube. Over this tube is wound the *primary* coil, consisting of two or more layers of relatively heavy insulated copper conductor. The *secondary* coil, wound in a number of small sections or in some cases on quite large spools, is then slipt over the primary, care being taken to thoroly insulate the two windings by placing the primary and core within a heavy walled insulating tube of hard rubber, or some other equally efficient insulator.

The closed core transformer, Fig. 2, has its magnetic circuit entirely closed and is therefore, as might well be imagined, the more efficient of the two. This is so for the reason that the magnetic flux produced by the primary coil P can complete its circuit entirely thru the laminated iron core which links the *secondary* winding *electromagnetically* with the *primary.* In the open core transformer, one end of the core is of a different magnetic polarity from the other and the magnetic flux has to thread its way from the *North* pole to the *South* pole, thru the air as shown in Fig. 3, and thus encounters an extremely high *reluctance,* as the term for magnetic resistance is known, thereby lowering the electrical efficiency considerably in this type of transformer.

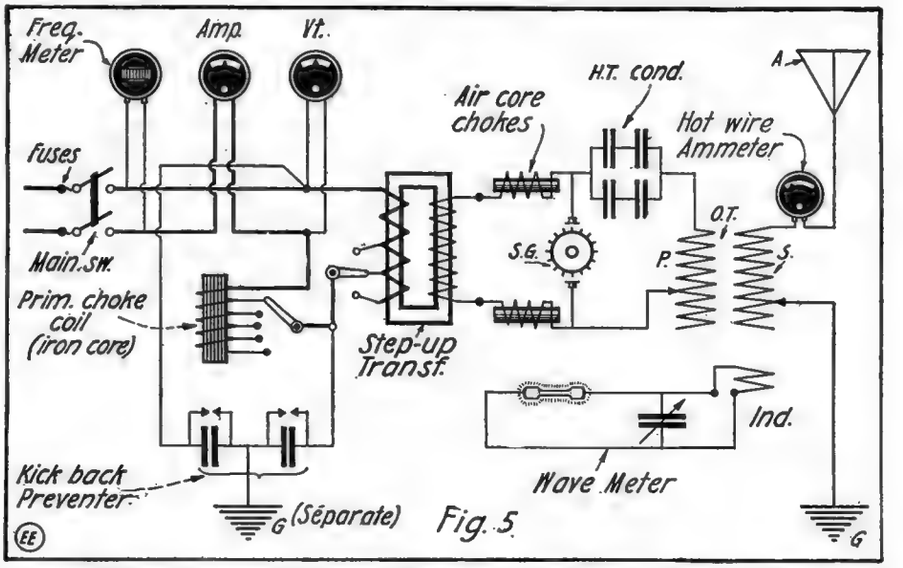
Referring to Fig. 1A, which illustrates an hydraulic analogy of the alternating current transformer, it is seen how a small quantity of water at high pressure may perform work or transform its mechanical energy thru the medium of a double cylinder pump, resulting in the water issuing from the large cylinder being expelled in a large quantity at low pressure. That is, suppose that the high pressure water stream enters the small cylinder at the right at a pressure of 100 pounds and with a quantity of 10 gallons. If this energy is utilized in pushing forward a piston connected to a steel rod and a large piston, in the cylinder at the left, fitted with a large efflux pipe, then the water in this cylinder will pass out in a large quantity, say 100 gallons at a low pressure, say 10 pounds. It is the same with the A.C. transformer. The primary winding corresponds to the small, high pressure water cylinder and may be supplied, for example, with a current of 10 amperes at a pressure of 100 volts. Considering that this transformer is of the step-down type, then the secondary (corresponding to the hydraulic analogy), may have a current of 100 amperes passing thru it at a pressure of 10 volts.



Principal Parts of an Open-Core Transformer; P—The Primary Coil and S—The Secondary.

Generally speaking, the voltage ratio between the primary and secondary windings is directly dependent upon the ratio existing between the number of turns in the primary coil and those in the secondary coil, i.e., if there are 2,000 turns in the secondary and but 100 in the primary, then if the applied primary potential is 100 volts, the *induced* secondary potential will be twenty times this value, or 2,000 volts, for the reason that 2,000 divided by 100 gives twenty as the *transformation ratio factor* for the two windings. Conjointly, the secondary current in amperes will be reduced accordingly and inversely it will be, theoretically speaking, one-twentieth of the primary current in amperes. Thus we see that no transformer can produce more energy in its secondary circuit than that passing thru the primary circuit. Moreover, no transformer ever built will produce the current and voltage values in the secondary as just stated, as there is always some loss due to the transformation actions occurring within the transformer, which loss depends upon the size of the transformer and also whether it is of the closed or open core type.

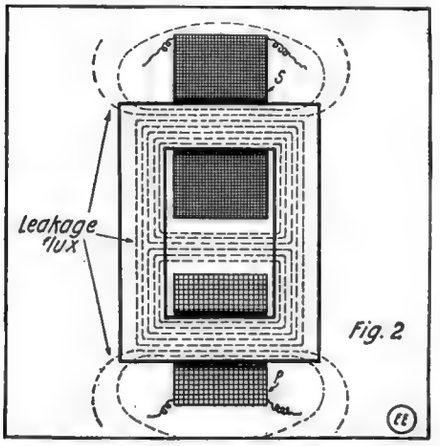
The usual efficiency figure for open core transformers is roughly 60%, but this of course will vary with the size and construction of the transformer. Closed core transformers realize as high as 85 and 90% overall efficiency, even in small sizes as low as 1 K.W. rating, and in large size commercial transformers used for lighting and power work, the net efficiency often reaches as high as 98% and more. This efficiency



Standard Wiring Diagram for Radio Transmitter, Comprising a Step-Up Transformer, Primary Choke Coil, Kick-Back Preventer, and Other Usual Apparatus.

expresses tne relation between the net watts *primary input* and the net watts *secondary output.*

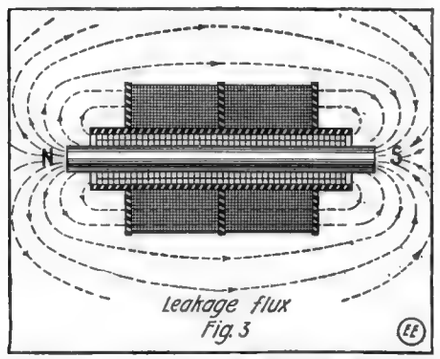
Thus, if a transformer is rated at 1 K.W. or 1,000 watts, it is usually understood that



Schematic Representation of Closed-Core Type Transformer, Showing Paths of Magnetic Flux and Leakage Lines. Efficiency 85 to 98 Per Cent, According to Size.

this is the secondary output, and if its gross efficiency was 94%, then the primary input would have to be 1063.83 watts and the difference between the two, 63.83 watts, would be that consumed by the iron and copper losses in the transformer.

Transformers operate in a manner analagous to the well-known induction or spark coil described in the First Paper of this series publisht in the November issue. The action in general is based on the fact that when an alternating current of any certain frequency is applied to the primary or exciting winding of the transformer, this will cause the iron core to become magnetized and demagnetized many times per second. This cycle of magnetization, first in one direction, then to zero and remagnetization in the opposite direction, occurs once for every cycle of the alternating current applied to the transformer; that is, if the primary current has a frequency of 60 cycles, then the magnetic flux set up will pass around the core first in one direction, and then in the opposite direction, at the rate of 120 times per second. As will become manifest, this will give rise to powerful induced currents in the adjoining secondary winding, which will have characteristics of a similar nature; that is, they will be currents similar in nature to those in the primary or alter-



General Appearance of the Magnetic Field About an Open-Core Transformer. Owing to Large Stray Field the Efficiency Is Low or in the Neighborhood of 60-65 Per Cent.

nating currents of like periodicity or frequency. The voltage or current may change, depending upon the design of the windings.

A great many people gain the idea that a transformer of the step-up or step-down type will change the frequency of an alternating current. But while this is so for certain peculiar arrangements of transformers and auxiliary coacting devices, this is not primarily so in the ordinary or garden variety of transformer generally found in experimental wireless and electrical laboratories.

The transformer, in the ordinary case, simply raises or lowers the applied primary potential or voltage with a consequent change in the current in amperes as previously explained.

Transformers always draw a small current, even with the secondary open, which is required for magnetization of the iron core. A transformer is said to be operating on zero load when the secondary circuit is open. With this condition of no current in the secondary winding, there is a very small current in the primary winding for the following reason:* The current in the primary winding will cause an alternating magnetic field to be set up thru both the primary and the secondary windings, which induces an electromotive force in both of them. This induced E.M.F. is in the opposite direction to the E.M.F. imprest upon the primary winding and very nearly equal to it. It is only this difference in E.M.F. that is available for producing a current in the primary winding, and since this difference is small, there will be a small current in the primary winding when there is no load on the transformer. This current is called the *no-load current* of the transformer. The induced E.M.F. in the secondary coil is in phase with the E.M.F. induced in the primary, and it is in opposition to the imprest E.M.F. on the primary, or the primary and the secondary E.M.F.'s are displaced in phase by 180°.

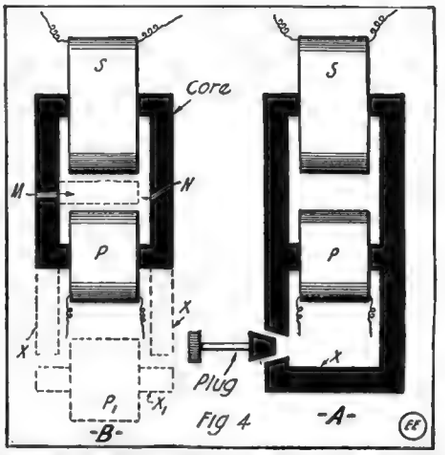
Now if the secondary coil of a transformer be connected to a receiving circuit and delivering a current, the transformer is said to be *loaded.* Since the E.M.F. induced in the secondary coil is 180° from that imprest on the primary coil, the current in the secondary coil will produce a magnetizing effect which tends to lessen that produced by the small current already in the primary coil. Hence the variations in the magnetic flux passing thru both of the coils is decreased, which results in a decrease in the induced E.M.F. in the two coils. This decrease in counter E.M.F. in the primary coil results in an increase in the difference between the imprest E.M.F. and the counter E.M.F. which results in an increase of current in the primary coil. If the load on the secondary coil be increased or decreased there will be a proportional increase or decrease of current in the primary coil.

The relative primary and secondary actions occurring in the transformer are best shown by means of a clock or vector (geometric) diagram. In Fig. 6 the magnetic flux that passes thru both the primary and the secondary coils is represented by the vector (Φ), and the no-load current by the vector (I_o). The E.M.F. induced in the primary and the secondary coils will lag the magnetic flux (Φ) 90°.

The E.M.F. imprest upon the primary coil is utilized in overcoming the resistance of the coil, the counter E.M.F. induced in the coil by the flux (Φ), which passes thru both windings and the effect of magnetic leakage. The E.M.F., to overcome the resistance, is in phase with the primary current (Ip), as shown in the figure; the vector (Ep) represents the E.M.F. required to overcome that induced in the primary coil by the flux (Φ), and the vector (2πfLp Ip) represents the E.M.F.

*See Practical Applied Electricity by D. P. Moreton for a more detailed discussion.

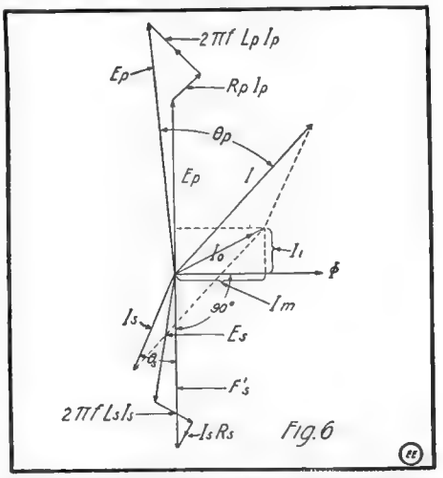
required to overcome the effect of magnetic leakage in the primary, which is 90° in advance of the primary current. The vector (Ep) represents the voltage imprest upon the primary coil.



Showing Several Types of Radio Transformers Provided with "Magnetic Shunts" for Varying the Reactance (and Current) of the Primary Coil, and Consequently the Secondary Current Also.

The voltage induced in the secondary winding is represented by the vector (Es) which bears the same relation to the E.M.F. induced in the primary coil as exists between the primary and the secondary turns, which has been assumed as unity in this case. This vector represents the voltage at the terminals of the secondary coil when there is *no load* on the transformer. When the secondary coil is supplying a current, the terminal voltage drops on account of the (IsRs) drop and magnetic leakage. These drops must be subtracted from the total E.M.F. induced in the secondary coil, which gives the terminal voltage equal to (Es). The drop (RsIs) is parallel to (Is), and the drop (2πfLsIs) is perpendicular to (Is). If the secondary coil is supplying a current (Is) there will be a current in the primary coil, which combines with the no-load current (I_o), giving the true primary current (I). In this diagram θ=angle of lag or lead.

There have been a number of odd transformer designs brought out in the past few years and intended especially for radio work; one of the best of these is shown schematically at Fig. 4-A. This repre-



Vector Diagram which Shows Graphically the Phase (Lag or Lead) of Transformer Primary and Secondary Currents and Voltages.

sents the well-known Thordarson transformer, in which the primary, and consequently the secondary, current is controlled

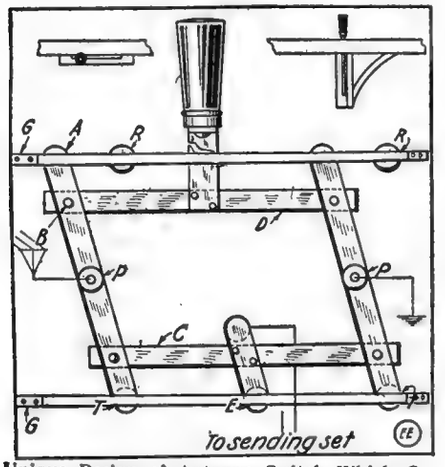
(*Continued on page 695*)

A CONCEALED TYPE ANTENNA SWITCH.

Practically all antenna switches which have been devised so far are designed to be secured at top of the instrument table or on the wall, and also they invariably do not present a very good appearance in combination with the rest of the apparatus.

To overcome this the design below is herewith suggested. It performs practically the same functions as most common antenna switches on the market and, as the sketch shows, it can be placed under the instrument table so that only the handle will protrude from the edge of the table in front of the operator, or it may be arranged for the handle to project from the top of the table. This makes a very neat arrangement indeed.

The details of the switch are very simple and, as seen, two metal blades "AA," made of brass or copper, are pivoted at "P." These blades are secured by rivets or screws at "B" to two fiber or hard rubber bars about 5 inches long, seen at "C" and "D." The lower fiber bar "C" carries a small stationary metal blade "E." In the position shown, this blade "E" closes a circuit between two switch buttons, which connect in series with the primary transmitting circuit of transformer. The aerial and ground connect with the pivot post "P," as observed; the receiving set connects



Unique Design of Antenna Switch Which Can Be Mounted Under the Table. Only the Handle Shows as Indicated in Upper Right Corner.

with the switch contacts "RR" and sending set with posts "TT." Two guide and tension strips "GG" serve to help line up the switch and give it a smoother action and also a better contact.

It is seen that this switch has a very simple motion, the handle always remaining vertical. A little oil on pivots will cause it to swing easily.

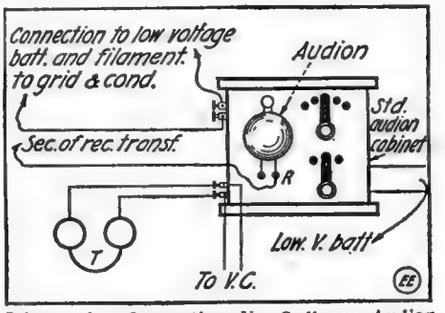
Contributed by E. L. H.

HOW TO MAKE ANY AUDION OSCILLATE.

An ideal oscillating Audion circuit must be one which is easily manipulated; it must be easily set oscillating; must require but little adjustment and should be suited to both damped and undamped waves, without any changes in the hook-up. Further it should require but little change from the ordinary Audion set and ought to work on short waves as well as long waves.

A circuit which fulfills the above requirements efficiently is herewith described.

In the ordinary Audion set there are two connections marked *tuner*. One of these leads to the grid condenser. The other is connected to the filament of the bulb. By opening the case the grid condenser binding post may be determined. One receiving transformer connection is made to this grid binding post. The second receiving transformer connection is joined to the plate, at the binding post marked "R" on the front of the Audion set. A variable condenser is



Scheme for Connecting Up Ordinary Audion so as to Oscillate. It Can Then Receive Undamped Wave Signals.

joined across the 'phones. No other changes in the circuit are required whatever.

The only additional instrument required over the ordinary amateur set is the variable capacity across the 'phones; this need be only of small capacity, say .0005 M.F.

To start this circuit oscillating, tune in any station and vary the capacity of the 'phone condenser. It is preferable to use quite loose coupling. After the bulb has been lighted for a few moments and is warm, with both aerial and secondary circuit in accurate resonance, it usually oscillates immediately if the proper 'phone capacity is determined. This is usually very little capacity. The fact that this circuit only operates when the primary and secondary circuits are in resonance is a great advantage, as there is no time wasted listening with the receiving set out of resonance.

To determine if the circuit is oscillating or not place the hand very near the secondary winding, and then draw it away; there will be a dull, *mushy* click, if it is oscillating properly.

When receiving undamped waves, the 'phone frequency can be varied to suit the operator by adjusting the shunt condenser across them.

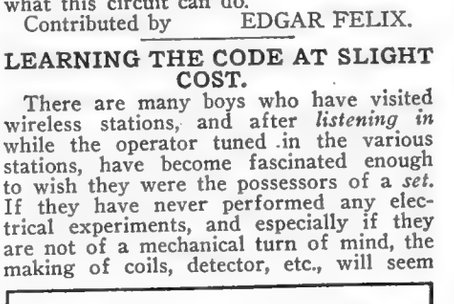
The author has obtained excellent success on 1,000 and 600 meter wave navy stations, which, although unreadable on the ordinary circuit, come in loud and strong. I have easily copied them on the typewriter as soon as the Audion oscillates.

Do not judge the circuit by the way it amplifies local signals. Listen in on your longest distance, weakest signal, and see what this circuit can do.

Contributed by EDGAR FELIX.

LEARNING THE CODE AT SLIGHT COST.

There are many boys who have visited wireless stations, and after *listening in* while the operator tuned in the various stations, have become fascinated enough to wish they were the possessors of a *set*. If they have never performed any electrical experiments, and especially if they are not of a mechanical turn of mind, the making of coils, detector, etc., will seem



Cheap Code Teaching Outfit Utilizing Induction Current on Aerial from Adjacent A. C. Circuit.

too difficult, and the fascination will soon disappear. If, however, they try the following simple experiment it will prove a stepping-stone to both the practice and theory of wireless.

Erect a small two or four-wire aerial adjacent and parallel to any alternating current circuit. If a high voltage is carried on these wires the aerial may be one hundred feet or even further away from them. In the country it is often possible to put up a low aerial on a fence near a power transmission line.

The only other things necessary are a telegraph key, a small condenser, and an ordinary 75-ohm telephone receiver. Any friend who understands something about electricity will show you how to insulate the aerial and how to follow the diagram of connections. The key and ground connection may be placed in a separate room. The condenser may be omitted, but doing so weakens the sound.

When the key is depressed, a note will be heard in the receiver, whose pitch depends on the frequency of the current. A sixty-cycle current gives a note slightly below "C" in the bass clef.

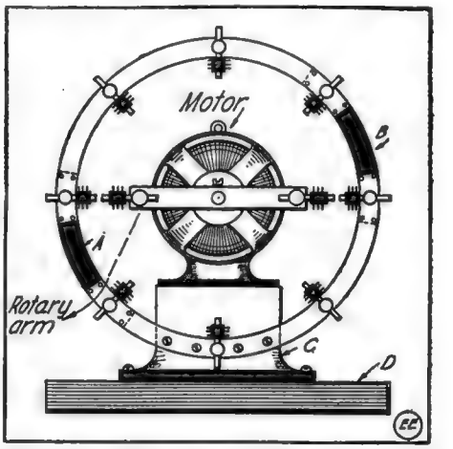
With this apparatus the wireless code may be practiced without the use of batteries, and what is more, it may be added to little by little until a complete wireless set is constructed.

The real foundation of wireless theory lies in *inductance and capacity*. With this simple outfit and a good text-book both of these subjects can be quickly understood.

Contributed by ROB TWEARL.

MARCONI TYPE ROTARY GAP.

The stationary ring A is a circle of edgewise-wound copper strip as used for mak-



Novel Form of Rotary Spark Gap for Experimenters. This Design Has Several Superior Features.

ing oscillation transformers, 7½ inches in diameter with eight binding posts mounted around at equal distances apart. On opposite sides the copper is cut away and replaced with Bakelite as A-B Fig. 1. The studs are made from a 3/16-inch round brass rod, cut in 2-inch lengths, threaded on one end half way. A nut is run on, then alternate thin copper washers ½"x¾" in diameter. C is a piece of ½-inch fiber to which the ring is bolted, and in turn fastened to the wood base D. The rotary member is a piece of flat brass strip 4 inches long, ⅝ inch wide, ¼ inch thick. In the exact center of one edge is drilled a hole the size of the motor shaft. A hole is also drilled and tapped for a set screw to hold the rotor on the shaft. The motor is bolted with machine screws to the base. If the rotor is not exactly in the center of the ring, the sparking-points can be adjusted.

Contributed by F. F. LAMBERT.

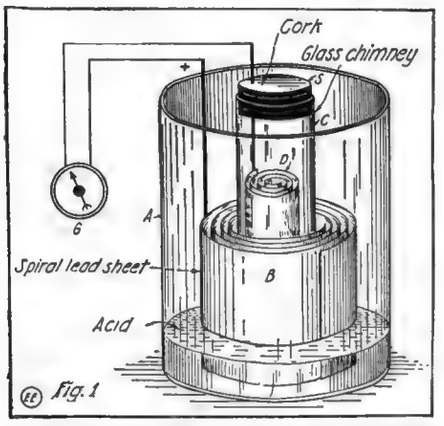
Tungsten contact points are being widely used in place of platinum ones on vibrators.

THE CONSTRUCTOR

Gas Batteries

By A. R. MacPherson

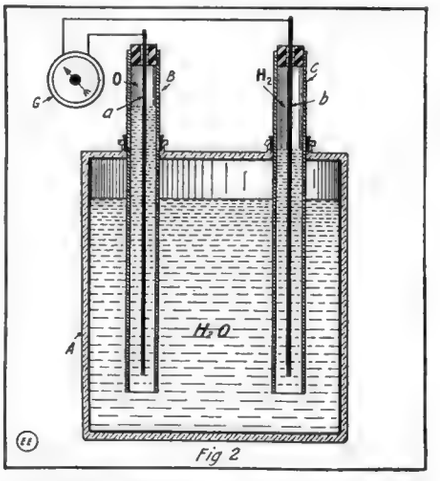
TWO experimenters interested in electricity and chemistry there is a very fascinating and comparatively little workt field in the construction and operation of gas batteries. Altho little has been accomplisht towards perfecting the gas battery as a commercial product, a patient research might reveal possibilities as yet undreamed of by scientists. When we consider the simple fact that a gas battery requires only two gases, one of which is highly electro-positive and one which is highly electro-negative, the solution of the problem then resolves itself into finding an economical chemical method of producing the two gases and causing them to combine. On consulting the table of chemical elements we find that hydrogen heads the list as being highly electro-positive, while oxygen concludes the list as being highly electro-negative. Thus with the most abundant elements of the earth, hydrogen and oxygen, it would seem very reasonable to take the oxygen from the air, and the hydrogen from the water, and produce a gas battery which would generate electricity on a commercial scale, and perhaps supersede the present methods of producing electricity.



A Simple "Coal-Gas" Cell Which the Experimenter May Readily Construct and With Which He May Study the Mode of Action of Such Batteries.

A simple coal-gas cell may be constructed as shown in Fig. 1, which will give the experimenter an insight into the working principles employed in this form of battery. Procure a glass jar "A" of convenient size, and a thin sheet of lead "B", about 5 inches by 7 inches, which is bent in a spiral form to fit the inside of the jar. Then obtain a glass chimney "C", placing it inside the larger lead spiral, and fit a second spiral lead plate "D" into this smaller chimney. The two connections for the lead-out wires are taken off at the top of the lead electrodes as shown. To operate this cell pour a dilute sulfuric acid solution into the outer jar to a depth of two inches, and hold the glass chimney over a gas-jet until it is filled with gas. Then close it up with a tight fitting stopper "S", and replace it carefully in the large jar. Connect the terminals to a galvanometer "G", and the current will be indicated by the deflection of the needle. Thus we have a current set up with the production of water and carbon dioxide gas, one lead electrode being surrounded by air while the other is surrounded by the impure hydrogen in the coal-gas.

Another experimental cell of this type is shown in Fig 2, and is known as Grove's "Gas Battery." This consists of a double-neck bottle "A", with two glass tubes "B" and "C" passing thru stoppers in the neck. Inside of the two tubes are attached platinum electrodes or strips, a and b, which possess the property of occluding, or absorbing hydrogen and oxygen. To act as a gas battery this cell must first be charged with an electric current from an outside source, giving about three volts. During this charging process the weak acid solution in the bottle is decomposed, yielding hydrogen which collects in the tube "C," and oxygen which collects in the tube "B", at the rate of

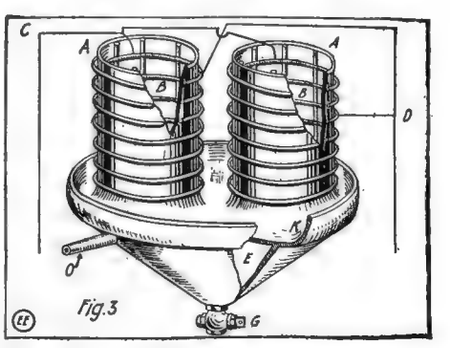


The "Grove" Gas Battery Comprising a Double-Neck Bottle with Two Glass Tubes Depending Downward, Inside Which Are Two Platinum Electrodes Immersed in a Weak Acid Solution.

two volumes of hydrogen to one of oxygen. When the tubes are filled with gas the wires are disconnected from the battery and attacht to the galvanometer "G." The gas battery will then be in action as indicated by the needle; water being again formed from combination of hydrogen and oxygen and an electric current generated. This cell illustrates both the storage and gas battery, as the electrical energy is first transformed into chemical potential energy in the form of the oxygen and hydrogen, and is then transformed into electrical energy again by the combination of hydrogen and oxygen to form water.

Another unique but complicated gas battery is that invented by A. Pletcher, a German scientist, and altho it is more of the ideal type of gas cell, it is impractical owing to the platinum used in its construction which renders it very expensive. Fig. 3 is a sectional view of this battery, which depends for its electrical action upon the combination of hydrogen and oxygen, brought about by the presence of finely divided platinum. It is constructed of a series of vessels "A", made from a mixture of clay with a platinum chlorid solution, which upon baking becomes hard, the platinum acquiring the finely divided condition. On the inside of the vessels is constructed a network of wires "B", fastened to the walls and connected to the one terminal "C". A similar system of wires is also built up on the exterior walls of the vessels and connected to the other terminal "D". Underneath the cells is a basin "E" with a pet-cock "G". The battery is operated by running a stream of hydrogen thru the opening "O" into the vessels, the oxygen being supplied by the surrounding atmosphere. Owing to the porous construction of the cells the two gases penetrate the walls and come under the influence of the platinum, which causes the oxygen and hydrogen to combine and form water with the production of an electric current. The water falls to the bottom of the basin "E", while that formed on the exterior walls is collected in the trough "K".

It is thus evident that the gas battery at the present time is in the experimental stage, serving only to illustrate the phenomenon of producing an electric current thru the combination of two gases. But there is every reason to believe that the ideal gas battery will soon be perfected, and man will have accomplisht the feat of harnessing that strange force known as chemical "affinity," and the transformation of the chemical energy of the atoms into the great electrical forces that will drive the machinery of the future. It has long been the dream of scientists to control the vast potential power that exists between the atoms and utilize it for commercial purposes, and with the perfection of the gas battery man will have realized another victory over the forces of nature.

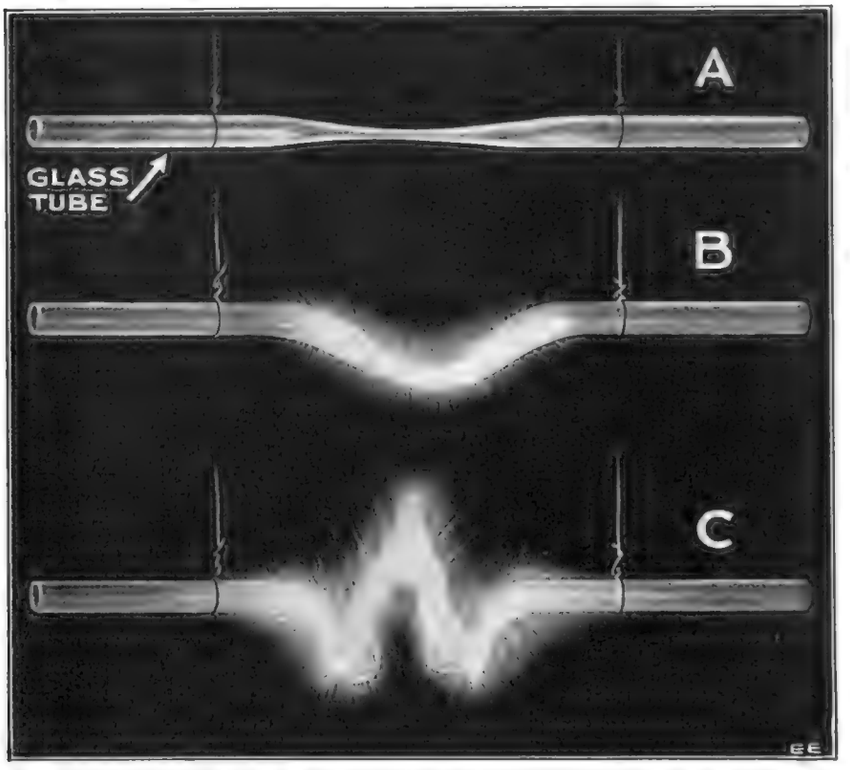


The Gas Battery Devised by A. Pletcher, Comprising Vessels Made of Clay Mixed with a Platinum Chlorid Solution. The Current Is Collected from Two Wire Networks on the Inner and Outer Surfaces of the Clay Vessels.

An Experimental Arc With Glass Electrodes

That glass, normally an excellent *insulator,* becomes a fair *conductor* when heated, has been mentioned in the July ELECTRICAL EXPERIMENTER.

A striking demonstration of this phenomenon is the production of a high-voltage arc between two glass electrodes.



Glass, Normally One of the Best of Insulators, Becomes a Conductor for Currents Having 2,000 Volts or More Potential, Under Certain Conditions, as Here Shown.

A transformer having a secondary voltage of 2,300 and a 1 k. w. rating is excellent for the purpose; a wireless transformer may be used if it is capable of furnishing 1/10 ampere secondary current.

Bare wire leads are joined to the secondary terminals of the transformer and twisted around a small glass tube about two inches apart. The tube must be quite small, not over ¼" diameter. If a larger tube is used it should be heated and drawn down to ⅛" or so as at sketch A.

Now turn on the primary current. Nothing happens; the glass insulates perfectly.

Then light a common match or candle and smoke the glass lightly. Be careful! The flame conducts! It is safer to cut off the primary current.

Now the film of soot conducts a current across, and rapidly heats up the glass. The soot burns off almost immediately, while the current continues to pass thru the glass, heating it to a bright yellow as at B. After half a minute the glass is quite soft and melts apart, leaving an air gap across which a broad yellow arc continues to pass, consuming the glass terminals rapidly, see C. Should the glass fail to melt apart, pull the tube in two by grasping the *cool* part, at a point at least three inches from the wire. Use one hand only.

That the current really *passes thru the glass* and not thru the *soot* may be proven by heating the glass with a soot-less blue flame, such as that of a Bunsen burner, blow torch or alcohol lamp. It is not necessary to bring the tube to a red heat if a large transformer is used, as the current will continue the heating effect.

If you still suspect that soot has something to do with the matter, you may do away with the flame by using a nail, driven thru a long stick to strike an arc between the wires, gradually leading the arc along the glass and heating it till the distance is short, so that the arc will hold. Then remove the nail and the arc, after sputtering a moment, will pass into the glass which, as before, is gradually heated to the melting point.

Contributed by S. KRUSE.

WHY GRAVITY BATTERIES FAIL TO WORK.

Many amateur electricians and some professionals experience considerable trouble with gravity batteries. They follow directions carefully and then fail to get good results. The usual trouble is not with the battery itself, but with the circuit. *A gravity battery is suitable only for a circuit which is normally closed.* It is, therefore, undesirable for operating electric bells, induction coils and all other open-circuit apparatus. The circuit should also have a high resistance. This makes it impractical for running fan motors, as the motor would have to be wound with fine wire and it would then require a large number of batteries to give a sufficiently high voltage.

The directions for setting up a gravity battery are as follows: Use about 3½ pounds of blue stone or enough to cover the copper element one inch. Pour in water sufficient to cover the zinc one-half inch. Short-circuit for three hours and the battery is ready for use. If desired for use immediately do not short-circuit, but add 5 or 6 oz. of zinc sulphate.

Keep the dividing line between the blue and white liquids about one-half inch below the bottom of the zinc. If too low, syphon off some of the white liquid and add the same amount of water, but do not agitate or mix the two solutions. Ordinarily this type of battery will give about .9 of a volt.

Contributed by KENNETH SWEZEY.

EMERGENCY "LEMON" BATTERY.

In an emergency it often happens that you need a small battery, especially in wireless work for operating detectors, 'phone tests, et cetera. To make such an emergency cell—copper, zinc, acid (citric acid)—proceed as follows:

Place one-half of a lemon in a cup, in a steady position. Cut one piece of zinc and one piece of copper, both of the same size and stick into the lemon, taking care, however, not to have the two touch each other in any way.

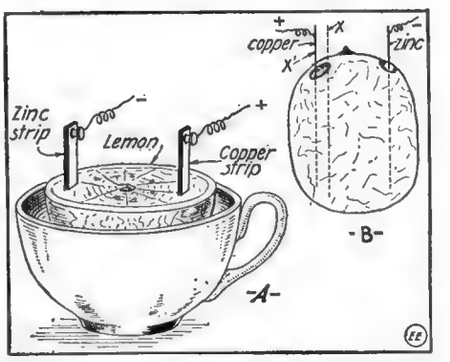
Connect the cell with wire and your battery is complete. By snapping the two ends of the wire together a tiny spark can be seen.

Contributed by HARRY DALALIAN.

[Editorial Note:—We were sufficiently interested in this "lemon" battery to try one. With two electrodes, one zinc and one copper, each 2¾ by ¼ by 1/32 inch, an E.M.F. (voltage) of 7/10 volt was obtained. The current was a fraction of an ampere, but gave good strong signals in a telephone receiver, sufficient for any testing work. The zinc plate acts as the positive electrode in the cell (— terminal) and the copper as the negative electrode (+terminal). When the external circuit is open no action ensues; when closed, citrate of zinc is formed at the zinc (+) electrode owing to the action of the citric acid. As the electrolyte is weak (about 5% citric acid, 95% water) no very powerful action takes place. Also the large amount of water, H_2O, present causes pronounced polarization, the hydrogen gas bubbles soon covering the copper (—) electrode, preventing further action if the cell is fairly well loaded. Unless some highly-oxidized substance is added to the electrolyte to produce oxygen, which combines with the hydrogen, forming water, therefore, the citric acid will become weakened by its action on the zinc, and the zinc will be consumed in time. The copper electrode is not attacked, except when some impurity exists in the electrolyte; citrate of copper was formed in minute quantities in one of the tests.

It is interesting to note that in a chemical test on 8,000 healthy lemons, there was produced 600 liters of juice, which tested from 4.5 to 6% citric acid (the balance mostly water). For rough testing the lemon may be cut in half as shown at A. Best results were obtained by simply cutting two ¼-inch holes at the top (see B), about 1" apart, the zinc and copper electrodes (well scraped) being inserted the full depth of the lemon in these holes. To reduce the internal resistance and to mitigate the loss due to the cellular suspension of the electrolyte, the two electrodes were placed about ¼ inch apart as at x_1, —x, with somewhat improved results. If the potential falls considerably, due to polarization, it was found that it could be temporarily restored by moving the copper plate up and down, or by removing it and wiping off the hydrogen gas film. A vinegar cell with zinc and copper electrodes is often used for test work. Here the zinc is converted into acetate of zinc and the copper (if attacked) into acetate of copper, as the solution is dilute acetic acid (with considerable water).—]

A higher voltage and less polarization



Even the "Lemon" Produces an Electric Current When a Copper and Zinc Strip Are Inserted in It, the Voltage Being About .7 Volt.

can be had by substituting a lead pencil for the copper. The softer the lead, the smaller the polarization. The amperage with pencil lead (due to the smaller area) is somewhat smaller than if copper is used.

The Measurement of Capacity

MANY electrical and radio experimenters have but slight knowledge of the means used in measuring the capacity of electrical condensers. The general method, followed by the every-day experimenter is to employ some formula in which the physical dimensions of the various parts are substituted.

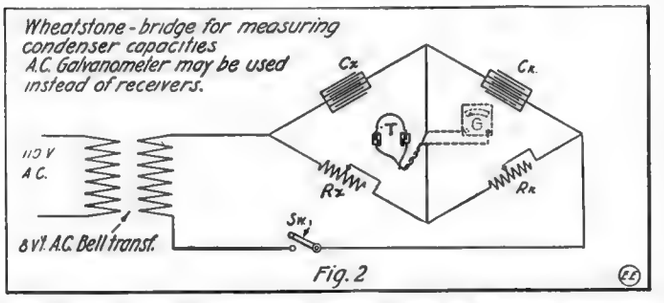
A common approximate formula for determining the capacity of any type condenser is:

$$C = \frac{2{,}248 \times K \times A}{d \times 10^{10}}$$

where C=Capacity in microfarads,
K=Inductivity of dielectric-taking air as unity, or 1,
A=Total active area of dielectric in square inches,
d=Thickness of dielectric in inches.

While this and other formulae hold good for general work, it is not accurate enough to determine the exact capacity; the only means of obtaining this is by actual measurement. It is the purpose of this article to explain two simple methods for measuring capacity so that the amateur can familiarize himself with them and make use of the methods here outlined.

A condenser of an unknown capacity can be readily measured by comparison with the known capacity of another condenser. This of course must be bought from a reliable company. In addition to this a *Ballistic* galvanometer, a double point key and a storage battery will be required. The connection for these instruments is shown in Fig. 1. The procedure is as follows:



How a Special Type of Wheatstone Bridge Is Used to Measure Condenser Capacity. A Galvanometer "G" Is Utilized when Battery Current Only Is Available.

The known capacity condenser is connected as shown and the key is closed (downward) so as to permit the current from the battery to charge the condenser *for 15 to 20 seconds.* The key is then released, thus discharging the condenser through the galvanometer, and in doing so a certain deflection will be noted on the scale. Several such operations are necessary before an average galvanometer reading is obtained. Having the average scale deflection of the condenser of known capacity, the unknown capacity condenser is substituted in the circuit where the first was connected. Several readings are taken just as with the condenser of known capacity.

The quantity of electricity stored in a condenser varies directly with its size. Therefore, the capacities of the two condensers are to each other as the deflections of the galvanometer. Consequently the expression for determining the capacity by the above method is:

$$\frac{D}{D_1} = \frac{Ck}{Cx}$$

where:
D=deflection obtained with condenser of known capacity,
D_1=deflection obtained with condenser of unknown capacity,
Ck=known capacity,
and Cx=unknown capacity,

Solving the above equation, we get:

$$Cx = \frac{CkD_1}{D}$$

A second method of measuring capacity is that employing an ordinary Wheatstone bridge. The arrangement of connections is given in Fig. 2, where Ck is the known capacity and Cx the unknown. They are placed on both arms of the bridge while the other two arms are composed of two known resistances, Rk and Rx. The current is obtained from a step-down transformer connected to 110 volts, alternating current supply, or it can be an ordinary hand-driven telephone magneto. The current feeds are shunted across the arms and a switch interposed. A telephone receiver is substituted for the galvanometer shown in dotted lines. When a battery is used a sensitive galvanometer can be utilized.

The operation is as follows: The current is sent through the bridge and both resistances Rx and Rk are adjusted until practically no hum is heard in the telephone receiver (or no deflection on galvanometer) and the values of the three known factors are given in the following equation:

$$Cx = \frac{Rk \times Ck}{Rx}$$

where: Cx=capacity of unknown condenser
Ck=capacity of known condenser
Rk=resistance of one arm
Rx=resistance of second arm

In using the above method it should be remembered that the resistances of the bridge *must be wound non-inductively.* The unit of capacity of the unknown will be the same as the standard condenser. Thus if the known condenser has a capacity of 02 microfarads, the unit of the unknown condenser capacity will be in microfarads.

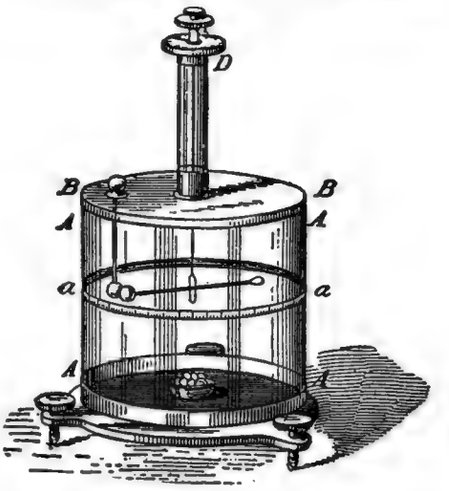
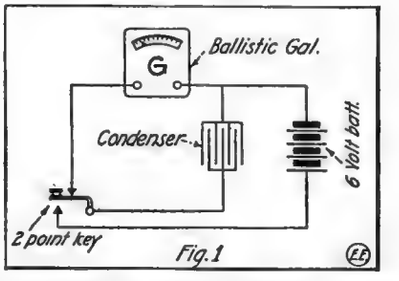


Fig. 3. The Ballistic Galvanometer Having Low Damping (Slow Swing) Used in Determining Condenser Capacity as Shown in Fig. 1.

An explanation of the construction of a Ballistic galvanometer as used in the electrostatic measurements will not be amiss here, as the majority of experimenters are unfamiliar with this instrument, though many would doubtless like to build one.

The Ballistic galvanometer is nothing more than an ordinary Coulomb's torsion balance as will be seen from Fig. 3. This consists of a light metallic rod with small brass balls a, a, on each end and supported by a fine metal wire, the torsion constant of which is known. The connections to the stationary electrode are made through B, while the movable one is connected through D. An adjusting knob is placed on top for resetting the movable rod. The parts are enclosed in a sealed glass case A, and a quantity of calcium chloride is placed at the bottom for absorbing any moisture that may be in the vessel.

When an electrostatic current is sent through the stationary and movable electrode, a certain amount of attraction or repulsion will result between the balls, depending upon the polarity in which they are charged, due to the electric charge between the balls. The amount of swing of the movable electrode is proportional to the quantity of electricity acting between them. The scale on the circumference of the glass vessel is marked in degrees and indicates the position of the movable electrode when a current is passed through.



Comparison Method of Checking Up Condenser Capacity, Utilizing a Ballistic Galvanometer for the Purpose.

This instrument is very easily made and if constructed correctly, it will find a valuable place in the laboratory of many experimenters.

SOLDERING WRINKLES.

Following are several hints on solders and soldering fluxes. A Valuable Soldering Liquid: Cut zinc into small pieces, dissolve in hydrochloric acid, add one-fourth part of the solution of ammonia and dilute with water. Dissolve in twelve parts of water one and one-half parts of glycerine and one and one-half parts lactic acid.

Soldering Paste: Make a syrup of starch paste with a solution of chloride of tin.

Fluxes for Welding: A secret well worth knowing is as follows: Take 6 ounces of common salt, 1 ounce of black oxide of manganese, 2 ounces of copperas, 1 ounce of saltpeter, 1 ounce of prussiate of potash; pulverize and mix with 3 pounds of welding sand.

Solders—How They Are Made. Soft spelter is made of 1 part copper, 1 part zinc; hard spelter, 2 parts copper, 1 of zinc; plumbers' coarse solder, 1 part tin, 3 lead; plumbers' seal solder, tin 1, lead 2; tinners' solder, tin 1½, lead 1; hard solder for copper, brass and iron, copper 2, zinc 1; silver solder for jewelers, silver 19, copper 1, brass 1; silver solder for plating, silver 2, brass 1; silver for silver, brass and iron, silver 1, brass 1; gold solder, gold 12, silver 2, copper 4; bismuth solder, lead 4, tin 4, bismuth 1.

Contributed by
EDW. C. CONNELLY.

HOW TO MAKE IT

This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of **$3.00** is awarded; for the second best idea a **$2.00** prize, and for the third best a prize of **$1.00.** The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

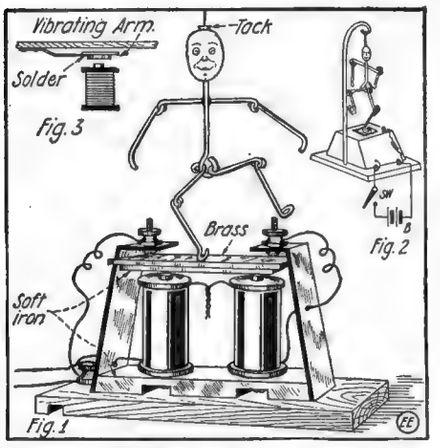
FIRST PRIZE, $3.00

AN ELECTRIC DANCING TOY.

Here is an electrical toy that will provide plenty of amusement, especially to the younger members of the family, and is well worth the time and trouble necessary to construct it.

The materials required consist chiefly of the remnants of a discarded battery bell, a few binding posts and screws and several pieces of aluminum or other wire.

The stand or base should be made first and may be of any size or shape according to one's taste. The top piece, however, must have holes for two binding screws and an opening, Fig. 2, so as to allow the feet of the dancing figure to rest on the vibrator. This latter, Fig. 3, consists of a brass piece with an under soft iron bar extending crosswise and soldered or fastened in some other convenient method to a brass strip, having tension enough to keep it forced upwards under normal conditions against two binding set screws, which act as contacts. The electro-magnets should be fastened directly under the soft iron bar of the armature, or vibrator, and



A Magnetically Operated Dancing Man which Can Be Made from Odd Parts.

the wire connections made as shown.

The dancing figure itself is very easily and quickly constructed. About eight pieces of ordinary battery wire, cut into about equal lengths, should be bent at the ends by means of pliers in a manner similar to Fig. 1, so as to allow freedom of motion. A hickory nut or a small wooden ball decorated with a few artistic touches of white paint and then placed on the upper end of the main wire will make the figure more realistic and ludicrous. When completed, hang by means of a string to a rod as illustrated in Fig. 2, which is inserted into a hole in the base of the toy.

Now that the toy is constructed, it may be well to know how it is to work. In the first place when we close the switch of the battery circuit, the current travels from the lower left hand binding screw to the upper one, thence via the armature to the right hand screw and through the magnets, thereby energizing them and causing the armature to be attracted downward, which action breaks the circuit. This alternate making and breaking being continuous, the armature rapidly vibrates and as the feet of the figure come in contact, the same motion is imparted to it.

Contributed by JOHN T. DWYER.

SECOND PRIZE, $2.00

EXTENSION PLUG MADE FROM "BLOWN" FUSE.

The accompanying illustration shows an extension plug which works to good advantage. As will readily be seen it is made from a burned out fuse plug. Having taken off the brass ring on the top and removed the mica disc, I shortened the broken fuse wire, soldered the lamp cord terminals to each end of the fuse wire, and punched two holes in the mica to keep the wires separated. Then I replaced mica disc and brass ring and connected the cord to a regular lamp socket. This home-made attachment plug can be used anywhere as it fits any socket.

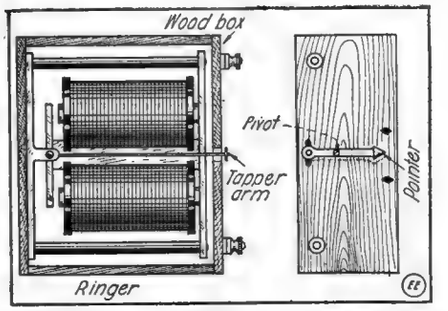
Contributed by GEO. M. VARETH.

A POLARIZED POLARITY INDICATOR.

A simple polarity indicator that can be used on any voltage up to 110 may be made from an ordinary polarized bell ringer and a small wooden box. Mount the ringer inside the box with the tapper extending through a small hole at one end of the box, as shown.

From a piece of tin cut a small pointer 1½ inches long. The center of this pointer is pivoted to the top end of the box, and the tapper arm inserted in a hole at the end of the needle.

Two binding-posts are mounted on the box at the lower edge. These posts should be wired to the ringer so that the pointer



Useful Polarity Indicator Constructed from Polarized Telephone Ringer.

will swing to the post which has a positive wire connected to it.

This can be tested by using an ordinary dry cell and changing the wires until the pointer swings to the binding-post which has the wire from the carbon of the cell connected to it.

This instrument may be mounted on a laboratory switchboard and will be found very useful to experimenters who frequently desire to test the polarity of wires without the trouble of tracing out the connections.

Contributed by A. T. LYNCH.

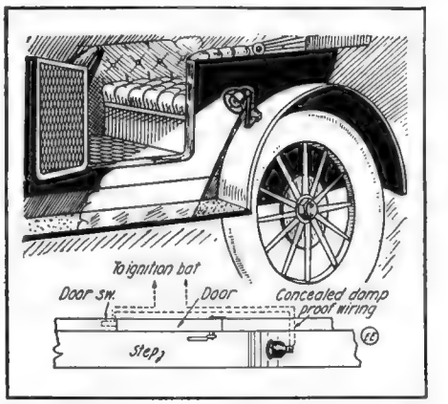
MAKING BLACK MARKS ON GRADUATED SURFACES.

The scale is varnished over with a little thin shellac varnish, so as to sink into all the cuts. When dry, a black varnish of lampblack and shellac is spread on, so as to fill all the cuts and this is allowed to thoroly dry. When hard the work is driven in a lathe, and the superfluous varnish polished off with fine flour emery cloth until only that in the cuts is left. This gives a very distinct marking and fine finish to scale.

THIRD PRIZE, $1.00

AUTOMOBILE STEP LIGHT.

How many times have you mist your step when entering your automobile at night? All owners of motor cars can obviate this inconvenience by installing or having installed a small battery lamp and reflector in line with the step of the auto, as the illustration indicates. The circuit of the lamp is controlled automatically by a spring switch, such as used for installation on burglar alarms circuits. This door-actuated switch may be purchased of any electrical supply house and should be mortised in the door frame on the car so it will look as neat as possible. Any garage



When the Auto Door Opens the Electric Light Illuminates the Step. Closing the Door Extinguishes It.

can install such a light together with suitable water-proof wiring and it can be supplied with current from the ignition battery of the car.

Contributed by ANDREW L. GALLAGHER.

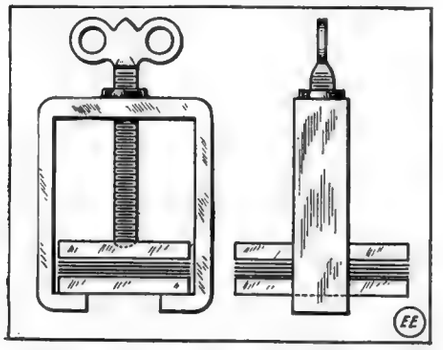
Don't fail to read the intensely interesting new serial "Experimental Physics" starting in the next issue.

LAMINATED SWITCH CONTACTS.

I wanted to use a copper plate about ⅛" thick for a fan switch but had nothing on hand but some sheet copper 1/32" thick, which was too limber. I cut some pieces the required size and covered both sides of all but two strips with solder.

Then put the pile of strips between two smooth flat iron strips and insert the whole in a clamp.

This is to be placed in a fire so as to melt the solder. As the solder melts tighten



Solid Copper Bars or Contacts Can Be Made by Clamping Several Thin Sheets Together and Sweating Them with Solder.

the screw. When all the solder is melted take it out of the fire and let it cool before loosening the screw. This is almost as good for some purposes as a solid piece.

The illustration shows the kind of a clamp that I used and is easily made.

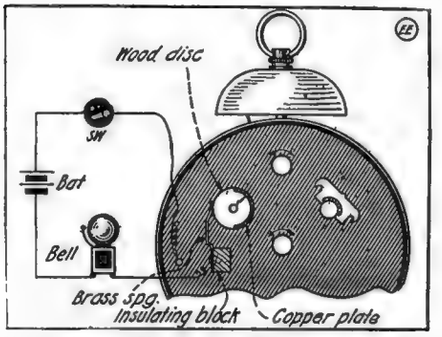
Contributed by
WALTER R. BENNETT.

AN ELECTRIC ALARM CLOCK WRINKLE.

From reading current publications it would appear that the amateur electrician has overtaxed his ingenuity in devising attachments for alarm clocks to ring an electric bell.

Most of those described, however, have been more or less makeshifts, unsightly or unreliable. The writer therefore believes that the device used by himself for over a year with excellent results will be of interest to those who use this type of alarm.

It was constructed by mounting a disc of wood ½ inch in diameter on the winding spindle of the alarm. One-half of the circumference of this disc was covered with copper sheeting electrically connected



Novel Electric Circuit Closer for Attachment on Alarm Clocks.

to the spindle by a short length of copper wire.

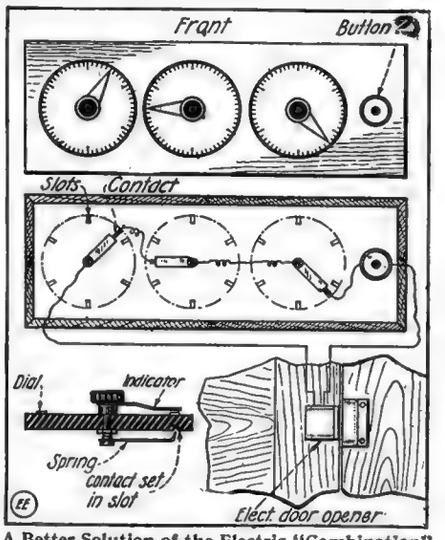
A brass spring supported by an insulating block as shown in the illustration presses against the face of the wood disc. The connections of this device are shown in the illustration. The operation of the alarm will be easily understood since the disc, as it revolves with the spindle, alternately opens and closes the bell circuit. The regular tapper on the alarm clock may be broken off or bent in such a manner as to prevent it from ringing.

This attachment does not mar the appearance of the clock or require resetting beyond making sure that the brass spring normally rests on the wood disc and not touching the copper plate.

Contributed by A. T. LYNCH.

THAT ELECTRIC "COMBINATION" LOCK.

To open the combination lock shown in the March ELECTRICAL EXPERIMENTER simply allow the contact switch to remain on any one of the points and, using a piece of bare copper wire, wind it around the contact points. Repeat the same process with the other two switches; press the button and Presto, the lock releases. In the improved design of a similar lock, illustrated here, it is quite impossible for anyone to



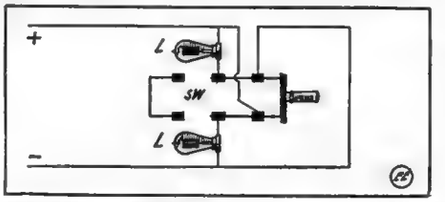
A Better Solution of the Electric "Combination" Lock Idea Recently Published on this Page. The Contacts Are Concealed in this Design.

thus short-circuit the live parts. In the rear view of the lock, the small piece to which the arrow points is the contact or switch point. The contact spring is set properly for the lock to be opened. The contact point should be of brass ½"x⅛" and ⅛" thick. This should then be firmly imbedded in the wood next to the number you have chosen. (Before doing this solder a foot or so of flexible wire to the piece of brass.)

Contributed by HYMAN JACOBSON.

SWITCHING TWO LAMPS FROM SERIES TO PARALLEL.

In your July, 1916, issue, an "Interesting Hook-up Explained" gives a method for changing two lamps from series to parallel connections by means of an ordinary, double-pole, double-throw knife switch. Here is a simpler arrangement for the same purpose and this connection has some advantages over the former one. In this case the terminals of neither lamp are reversed, as the switch is thrown from one side to the other. The connection may therefore



Good Switching Scheme to Connect Two Lamps in Series or Parallel.

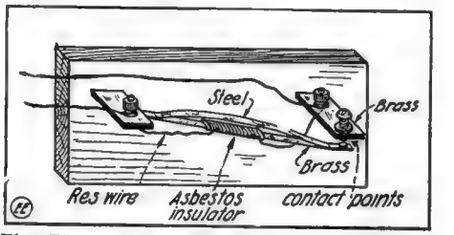
be used for two batteries or two single cells, to double the voltage when the switch is closed to the left; and to halve the voltage when thrown from left to right.

Contributed by B. B. BRACKETT.

A THERMO FLASHER FOR LAMP CIRCUITS.

A thermo flasher for battery lamp circuits is easily made as shown in the illustration.

The base is of hard rubber or fibre; the standards are of brass, screwed to the base through binding posts. The lever is a piece of steel and brass. Pro-



The Electric Current Passes Thru the Coil, Heating the Strip, Causing it to Bend Upward and Close the Circuit. It then Cools and Opens the Circuit, etc.

cure a small piece of asbestos paper, place it on the brass strip and wind a few turns of No. 26 B. & S. gage resistance wire over it. I think the drawings will enable the reader to gain a clear idea of the device.

Contributed by OTTO CLAWSON.

TO BORE A HOLE IN HARDENED STEEL.

Melt a small quantity of wax and pour it on to the steel. Make a hole in the wax of the dimensions desired.

Then put a few drops of nitric acid in the hole and leave it for some time. If not eaten through in 15 or 20 minutes wash the acid off and apply another dose. Continue this until the hole is eaten through.

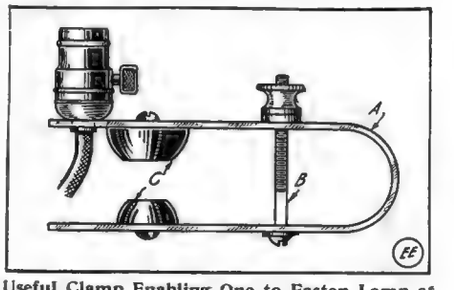
Non-rusting soldering fluid:—While the zinc chloride soldering flux works nicely on steel, so far as soldering goes, it should not be used where there is danger of rust. A solution that will not cause rust, is made by mixing

6 oz. alcohol
2 oz. glycerine
1 oz. oxide of zinc

Contributed by LOUIS WILLIAMS.

A HANDY CLAMP FOR INCANDESCENT LAMPS

In the accompanying sketch there is shown a very serviceable adjustment clamp for the purpose of securing the incandescent lamp to any part of a machine or other fixture. The clamp consists of a piece of



Useful Clamp Enabling One to Fasten Lamp at any Point Desired.

metal about 1/16" thick by 1" wide, as indicated at A. A long No. 8-32 machine screw with thumb nut is placed as shown, so that the clamp may be compressed as desired to lock it in any desired position. Two fibre or soft rubber (gasket) pads C, are riveted or screwed to the clamp A, so as not to mar the furniture on which the lamp is placed and also to provide a better grip. A piece of flexible lamp cord leads to the key socket, and this is provided with a standard attachment plug at its free end.

Contributed by FOREST B. TURNER.

"ELECTRO" WIR

New York City, N. Y., December, 1916.

MR. WIRELESS AMATEUR,
Anywhere, U. S. A.

My Dear Sir:—Perhaps you have heard of the Electro Importing Co. before. Perhaps you are one of the countless satisfied users of E. I. Co. apparatus. But do you know these FACTS which can be readily proved by anyone?

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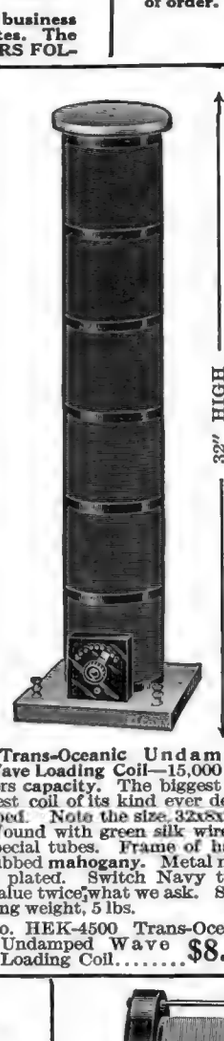
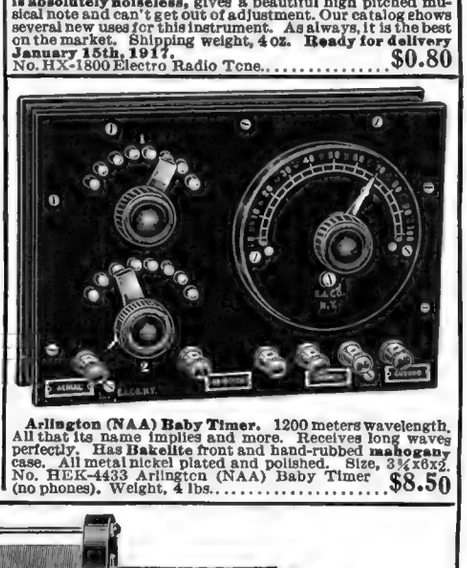


Trans-Oceanic Undamped Wave Loading Coil—15,000 meters capacity. The biggest and best coil of its kind ever developed. Note the size, 32x8x8 in. Wound with green silk wire on special tubes. Frame of hand-rubbed **mahogany.** Metal nickel plated. Switch Navy type. Value twice what we ask. Shipping weight, 5 lbs.

No. HEK-4500 Trans-Oceanic Undamped Wave Loading Coil..... **$8.50**

The Electro Radio Tone. The newest thing in wireless. A perfect test buzzer at last. Has rubber composition case, **is absolutely noiseless,** gives a beautiful high pitched musical note and can't get out of adjustment. Our catalog shows several new uses for this instrument. As always, it is the best on the market. Shipping weight, 4 oz. **Ready for delivery January 15th, 1917.**

No. HX-1800 Electro Radio Tone..... **$0.80**

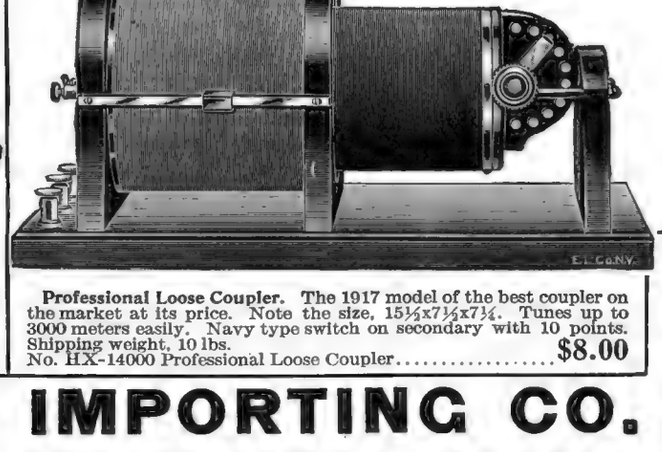


Arlington (NAA) Baby Timer. 1200 meters wavelength. All that its name implies and more. Receives long waves perfectly. Has **Bakelite** front and hand-rubbed **mahogany** case. All metal nickel plated and polished. Size, 3¼x6x2.

No. HEK-4433 Arlington (NAA) Baby Timer (no phones). Weight, 4 lbs..... **$8.50**

Electro Professional Wave Meter.—The simplest and best instrument of its kind ever offered the public. Has two exploring coils for different capacities. Is supplied complete as shown with full directions and calibration curves. Woodwork hand-rubbed mahogany. Shipping weight, 10 lbs. Reads from 180 to 1800 meters. Accurate to within 3%. Ready for delivery Jan. 1st, 1917.

No. HZ-4488 "Professional" Wave Meter..... **$8.00**



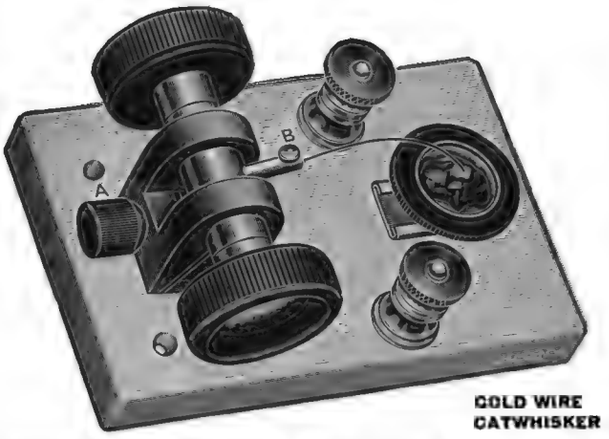
Professional Loose Coupler. The 1917 model of the best coupler on the market at its price. Note the size, 15½x7½x7¼. Tunes up to 3000 meters easily. Navy type switch on secondary with 10 points. Shipping weight, 10 lbs.

No. HX-14000 Professional Loose Coupler..... **$8.00**

THE ELECTRO IMPORTING CO.

ELESS NEWS

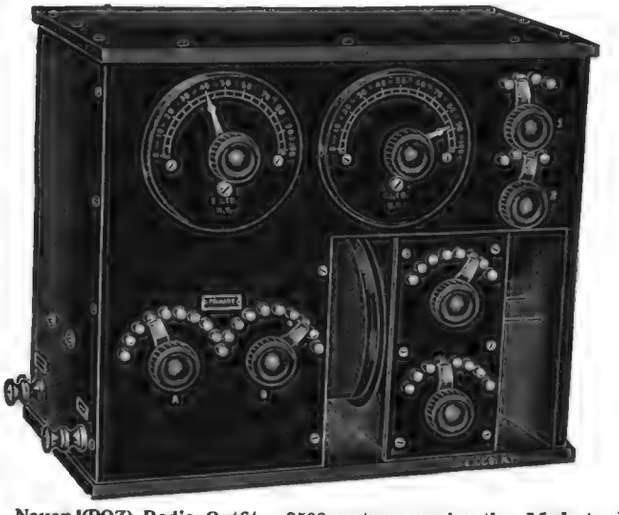
Sayville (WSL) Radio Outfit. 2500 meters wavelength. A de luxe cabinet that is compact, efficient, good looking and yet is not expensive. All tuning is by switches, and the front is of **Bakelite,** the metal highly nickeled and the case is of hand-rubbed **mahogany.** Size, 12x10x5½. Shipping weight, 9 lbs.
No. AHX-4455 Sayville (WSL) Radio Outfit (no phones) **$18.00**



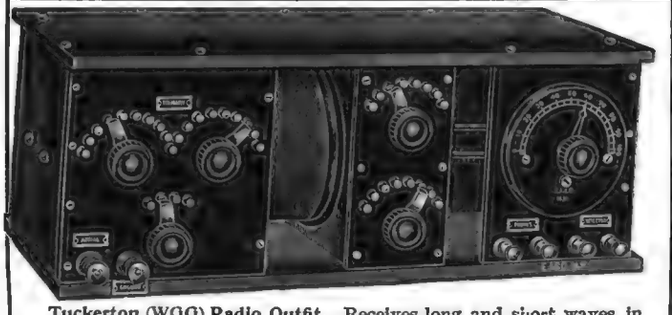
COLD WIRE CATWHISKER

Radiocite Detector. The newest and best on the market. Most easily adjusted and **only one that LOCKS its adjustment.** Radiocite crystal furnished; also **solid gold** catwhisker. Heavy **Bakelite** base. Shipping weight, 3 lbs.
No. CEK-8888 Radiocite Detector **$3.50**

Key West (NAR) Radio Outfit. 2000 meters wavelength. Combines more value in a small outfit than any outfit we make. Has made some wonderful long records in tests. **Bakelite** front, nickeled metal, and hand-rubbed **mahogany** case. Size, 8x8x4½. Shipping weight, 6 lbs.
No. ADX-4444 Key West (NAR) Radio Outfit (no phones) **$14.00**



Nauen (POZ) Radio Outfit. 3500 meters wavelength. Made to do just what its name implies, to receive European messages, **and does it.** Has a remarkable Navy type receiving transformer and condensers. Entire front of **Bakelite,** metal highly nickeled and case, size 17½x11½x7, is of hand-rubbed **mahogany.** A perfect instrument at a very reasonable price. Receives up to 3500 meters without extra coils. A real bargain
No. CIX-04477 Nauen (POZ) Radio Outfit (no phones)..... **$39.00**



Tuckerton (WGG) Radio Outfit. Receives long and short waves in great style. Has the most wonderful Navy type loose coupler you have ever seen. All fronts of **Bakelite,** metal nickeled and case of hand-rubbed **mahogany.** Size, 21½x7x6¾ in. Shipping wt., 15 lbs.
No. BVX-4466 Tuckerton (WGG) Radio Outfit (no phones). **$26.00**

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Experimental Chemistry

By Albert W. Wilsdon

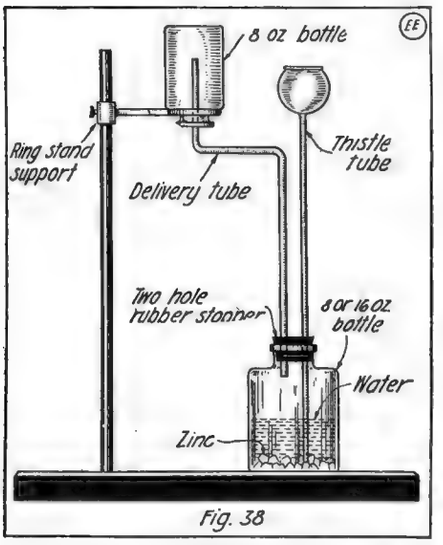
Eighth Lesson

HYDROGEN.

[Experimental.]

EXPERIMENT NO. 25.

PLACE a few pieces of Zinc [Zn] in a test tube [Fig. 39a] and set in a test tube rack [Fig. 39b]. Partially fill the test tube with water as shown. Add a few cubic centimeters of Hydrochloric acid [HCl], 5 or

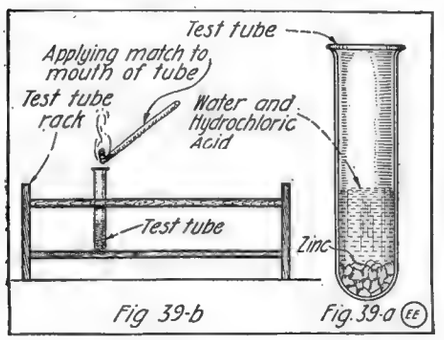


The Preparation of Hydrogen by Upward Displacement. Reaction of Zinc and HCl.

10 cc. should be sufficient. Watch the action and make notes of what happens in the water and to the Zinc.

[It may be found that the above quantity of acid will not produce any visible action on the Zinc, if such be the case add a few cc. more. If upon the addition of more acid, the reaction does not take place with fairly rapid evolution of gas, you may gently heat the solution over a Bunsen burner, holding the tube by means of a test tube holder, for a few minutes, or in other words till gas is generated, evidenced by the rapid flow of bubbles thru the tube. Be careful not to let the solution boil, and if it has a tendency to do so remove the tube from the flame.]

After generating a few minutes [which is made apparent by the evolution of small gas bubbles] apply a lighted splint to the mouth of the tube, and record the results.



(At Left)—Evolution of Hydrogen by Reaction of Zinc and Dilute Hydrochloric Acid. (At Right)—Showing Water and Acid Solution and Zinc.

Compare these results with those obtained by Experiment No. 23.

The reaction which is taking place in the tube is as follows:

$$Zn + 2HCl = ZnCl_2 + H_2$$

Zinc Hydrochloric acid Zinc Chlorid Hydrogen

EXPERIMENT NO. 26—

After thoroly washing the test tube used in Experiment No. 25 [or if desired Experiments Nos. 25, 26, 27, 28 may be performed together, by placing each of these tubes by the side of each other in a test tube rack, and the comparison of each reaction may be made while each reaction is taking place] proceed in the same manner as in Experiment No. 25, but substitute Sulfuric acid [H_2SO_4] in place of the Hydrochloric acid. Record the results in your note book.

Do you notice any difference after applying a lighted splint, with the results obtained in Experiment No. 25? [The directions for heating the acid in Exp. 25 may be used in this case if the reaction does not take place after adding more Sulfuric acid.]

The reaction which occurs in this Experiment is as follows:—

$$Zn + H_2SO_4 = ZnSo_4 + H_2$$

Zinc Sulfuric Acid Zinc Sulfate Hydrogen

EXPERIMENT NO. 27—

In place of the Zinc, after thoroly washing the test tube, if separate tubes are not used, try the reaction of Hydrochloric acid and Iron [Fe], using the same apparatus and procedure as in the preceding experiments. Record your results as before.

The reaction which should take place is as follows:—

$$Fe + 2HCl = FeCl_2 + H_2$$

Iron Hydrochloric acid Ferrous Chlorid Hydrogen

After again thoroly washing the tube, try the reaction of Sulfuric acid [H_2SO_4] and Iron [Fe]. The reaction should be:—

$$Fe + H_2SO_4 = FeSO + H_2$$

Iron Sulfuric Acid Ferrous Sulfate Hydrogen

EXPERIMENT NO. 28—

In place of the Zinc or Iron, put a piece of Copper [Cu] in a test tube and partially fill with water as in Experiment No. 25. Set the tube in the rack next to either of tubes as used in any of the foregoing Experiments. Add about 5 or 10 cc. of Nitric acid [HNO_3] to the tube containing the copper and water.

Notice the color of the solution, the color of the fumes, etc. Make notes.

After the action has begun with fair rapidity, apply a lighted splint to the mouth of the tube. Compare the results with any of the foregoing experiments. See if you can explain the difference.

Caution:—When carrying out experiments in which Nitric acid is one of the reagents, carefully avoid inhaling any fumes which may arise in the vessels or retorts, as a poisonous gas, Nitrogen Monoxid [NO] is sometimes liberated. It is advisable to work all experiments near a window or where a draft can be created.

The reaction which took place in this Experiment is:—

$$3Cu + 8HNO_3 = 3Cu(NO_3)_2 + 4H_2O + 2NO.$$

Copper Nitric Acid Copper Nitrat Water Nitrogen Monoxid

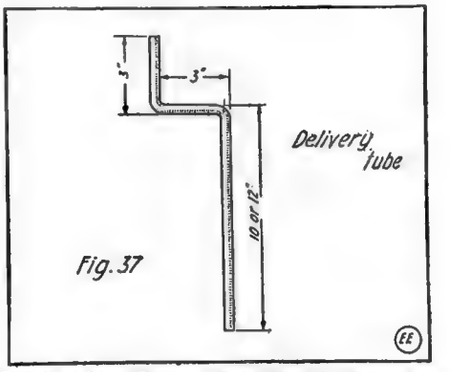
It will be seen from this reaction that no hydrogen is liberated, but the products obtained are Copper Nitrat [$Cu[NO_3]_2$], Water [H_2O] and Nitrogen Monoxid [NO].

EXPERIMENT NO. 29—

Partially fill an 8 ounce bottle with water as shown by Fig. 40. Take a piece of metallic Sodium [see NOTE] about the size of a pea and drop into the water, covering the vessel with a piece of *paper* or *cardboard*. Never use a *glass* plate, as a slight explosion may occur upon the disappearance of the Sodium, and if a glass plate were used to cover the vessel it might result in injury, if the glass should break. Therefore never use glass.

Metallic Potassium [K] may be used in place of the Sodium [Na], in the same manner as above, observing the same precautions.

[*NOTE:—The metallic Sodium* [*Na*] *and Potassium* [*K*] *are kept under kerosene oil. When a small piece is wanted, take out a large piece from the bottle and roughly wipe off the oil with filter paper, rolling the same on the work-table. Cut off a piece the size needed. It is not advisable to use a piece larger than a pea.*]

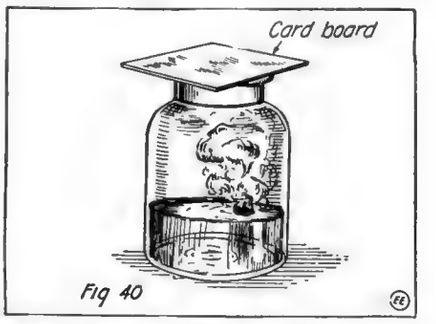


Detail of Glass Delivery Tube Used in Collecting Upwardly Displaced Hydrogen.

Be cautious not to allow any of the Sodium or Potassium to come in contact with the skin, but when handling it, do so by means of a pair of forceps. After you have performed the experiment, it is advisable to hold the forceps with which the Sodium or Potassium was held in the flame of a Bunsen burner and burn off any of the metal which may have adhered to them.

Also be careful not to allow the Sodium or Potassium to come in contact with water, as it readily absorbs the same and may become inflammable. It should be placed in the vessel where it is to be used as soon as possible, and the remaining portion replaced in the bottle containing the kerosene oil, as there is always a percentage of moisture in the atmosphere, which would be readily absorbed by the Sodium.

If any of the metal should flame up *never pour water on it to extinguish it*, but have handy a box of sand or loam, and

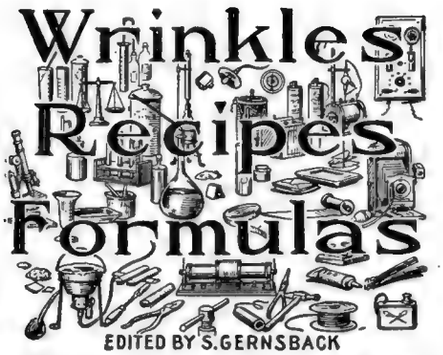


Showing Liberation of Hydrogen by Action of Metallic Sodium or Potassium on Water.

blanket the flame with either of these. To pour water on the flames would cause it to burn with more intensity.

The reactions which accompany the da-

(*Continued on page 692*)



Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTER'S APHORISMS

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

(10) For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products. S.G

MAKING MIRRORS BY ELECTRICITY.

A rapid and admirable method for depositing suitable metals on the surface of glass so as to produce mirrors consists of decomposing the metal by means of a high potential electric current. It is thus described in the *Physikalische Zeitschrift* by G. Rumelin.

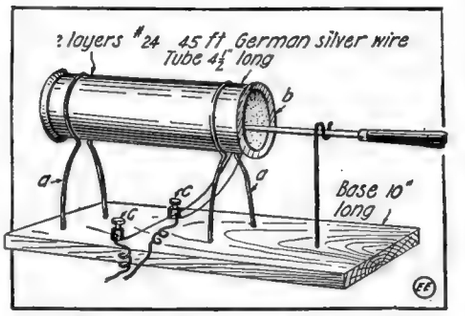
A metal plate is placed in juxtaposition with the glass plate which is to receive the coating. The two plates are then placed flat on a table beneath the receiver of an air-pump suitable for producing a high degree of vacuum, such, for example, as the rotary molecular pump of Gaede.

A small quantity of an inert gas, such as hydrogen, is introduced into the vacuum and a high potential current is then turned on by means of the negative pole of a suitable source of electricity, this pole being attached to the metal plate. Thirty seconds duration of this cathodic flow is sufficient to obtain a properly silvered mirror.

Besides silver such metals as gold, copper, platinum, nickel, iron, palladium and iridium may be employed.

ELECTRIC SOLDERING IRON HEATER.

The tube here shown is made of sheet iron or steel bent around a 1¼-inch pipe. Remove it and bend up the edges about ¼ inch to hold on the winding and insulation. First wind two layers of mica around the tube, then one layer of No. 24 German Silver resistance wire, then two more layers of mica and another layer of wire. The total length of wire is 45 feet or so, as found by experiment. These are brought



Electric Heater for the Soldering Iron, Comprising a Metal Tube Wound with Several Yards of Resistance Wire.

out to the binding posts and connected to the 110 mains. This is a fine heater, heating the iron in 1½ to 2 minutes and will last a long time if properly handled.

Contributed by OSCAR RUZEK.

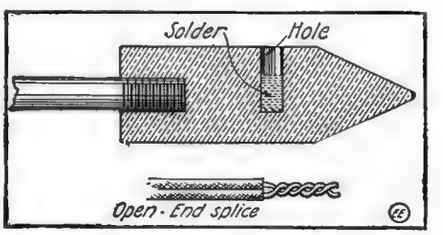
EXPLOSIVE PAPER.

Dissolve some Iodine crystals in aqua-ammonia; the amount makes no difference and the crystals should not be entirely dissolved for best results. Then pour the solution in a filter paper to filter. The precipitate should then be put on different pieces of paper and left to dry. When dry the paper will explode if touched; the thicker the precipitate has been put on the paper the louder the report. A joke can be played on anyone by placing it, when almost dry, where they will touch it when it is dry. Don't handle when dry because it will explode very easily. The explosions are harmless to anyone but they cause heat and for this reason care should be taken where they ignite. The correct proportion can best be found by experiment, since it differs with the material. I found 1 part of Iodine to 5 parts of ammonia to give good results.

Contributed by RUSSEL O. SHADEL.

RELATING TO THE SOLDERING IRON.

I have found that by drilling a hole in the side of a soldering iron and filling it with solder, that splices of the open-end



A Time-Saving Kink for Rapidly Soldering Twisted Wire Joints. A Solder Well Is Formed by Drilling a Hole in the Copper.

style may be soldered with much better results than by using the tip of the iron. The iron is heated until the solder in the hole melts, then the splice, already covered with paste, is pushed into it. This makes a very well soldered joint. The hole should be about ¼" x ⅝".

Contributed by HENRY ABRAHAM.

INK FORMULAS.

1. Ink for Porcelain:—Colophony resin, 20 parts; Borax, 35 parts; Alcohol, 150 parts; Water, 250 parts. Nigrosine in sufficient quantity. Dissolve the resin and nigrosine in the alcohol and the borax in the water and mix both solutions.

2. Stamping Ink:—Manganese phosphate, 30 parts; Hydrochloric acid, 60 parts; Anthracence, 15 parts; Potassium chromate, 7.5 parts; Gum acaia in sufficient quantity; Water, 7.5 parts. Dissolve the manganese phosphate in the hydrochloric acid, make a mixture of the anthracence, potassium chromate and water, and shake. Mix the whole vigorously, adding sufficient gum acaia to maintain suspension.

3. Typewriting Ink:—Transparent soap, 1 part; Glycerine, 4 parts; Water, 12 parts; Alcohol, 25 parts; Aniline dye, sufficient quantity. Dissolve the soap in a mixture of the glycerine and water by aid of heat, and finally the aniline dye dissolved in the alcohol.

4. Red Typewriting Ink:—Bordeaux red, 1 part; Aniline red, 15 parts; Oelic acid, 45 parts; Castor oil, sufficient quantity, approximately 1,000 parts. The coloring matters are triturated with the oelic acid. The castor oil is then added and the whole heated at 100 to 110 degrees, under constant agitation.

5. Red Copying Ink:—Extract of logwood, 80 parts; Water, 1,000 parts. Dissolve with the aid of heat under constant stirring and add Potassium bichromate, 10 parts. After solution is effected add nitric acid, 30 parts. After shaking thoroughly add to thicken dextrin, 60 parts; water, 60 parts; salicylic acid, 1.5 part.

6. Universal Ink:—Extract of logwood, 16 parts; Hot Water, 200 parts. To the solution add Chrome alum, 16 parts; Potassium chromate, 660 parts.

7. Black School Ink:—Extract of logwood, 8 parts; hot water, 180 parts. To the solution add Potassium bichromate, 1.3 parts; hot water, 20 parts; Hydrochloric acid, 3.5 parts.

8. Indelible Ink:—Extract of logwood, 20 parts; boiling water, 280 parts. After solution has been effected, mix it with a liquid composed of solution of Potassium bichromate, 3.5 parts; hot water, 20 parts; Hydrochloric acid, 8 parts.

Contributed by FRED BABBITT.

TO SILVER BRASS OBJECTS.

Mix 3 parts chloride of silver, 20 parts powdered cream of tartar, 15 parts powdered common salt. Moisten a suitable quantity of the mixture with water, rubbed in with a piece of blotting paper. Take the blotter, which should be moist, and rub the article (brass) to be silvered. Wipe off any dust on the article and rub with a piece of cotton which has been dusted with precipitated chalk. Then wash in water and polish with a cloth.

INK FOR WRITING ON METALS.

Formula:

Muriatic Acid .....1 oz.
Nitric Acid .....½ oz.

Cover the portion of the metal you wish to write upon with melted wax and allow to cool. Write the inscription plainly with any sharp instrument through the wax to the metal.

Apply the mixture with a feather or rag, carefully filling each letter, and let it remain from 1 to 30 minutes, according to the depth desired; after which wash off the wax and mixture, and rub over with a little sweet oil to prevent further tarnish or rust.

Contributed by W. P. MENGEL.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month **$3.00** prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

AMATEUR RADIO STATION CONTEST.

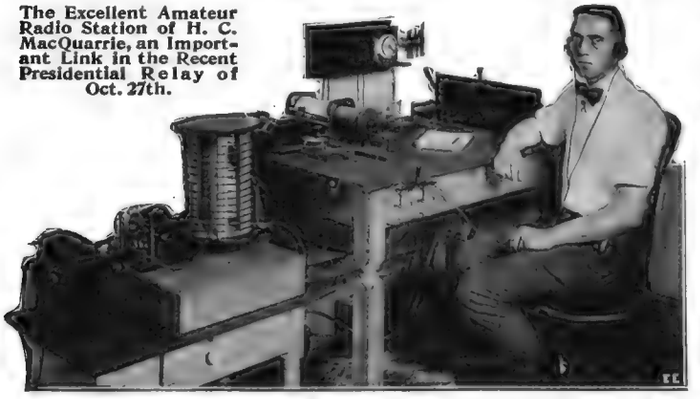
Monthly Prize, $3.00.

This month's prize-winner.

RADIO STATION OF H. C. MACQUARRIE.

The accompanying is a photograph of my station, 6SH. It uses a rotary spark gap and a 1 K.W. Thordarson flexible type transformer on 110 A.C.

The receiving side consists of a loose coupler designed to receive up to 2,500 meters and a loading coil for 2,000 meters more, thus giving a long range in wave lengths; also a variable for use of short waves. I have an Audiotron panel and an interchangeable switch to change to a compound galena detector.



The Excellent Amateur Radio Station of H. C. MacQuarrie, an Important Link in the Recent Presidential Relay of Oct. 27th.

It will be noticed that on the right of the photograph there is a switchboard for all the various controls desirable as in using a double antenna. The tuning is done on the left, leaving the right hand free to write when once the change-over is made.

H. C. MACQUARRIE.

Stockton, Cal.

OCTOBER MEETING OF THE INSTITUTE OF RADIO ENGINEERS.

A very interesting paper was delivered by Edwin H. Armstrong at the meeting of the Institute of Radio Engineers held at the Engineering Societies Building, New York City, on October fourth.

The paper was entitled "A Study of Heterodyne Amplification by the Electron Relay."

Mr. Armstrong's paper dealt entirely with the experimental data obtained. Both the regenerating Audion and the crystal rectifying detectors were employed as receivers for the continuous waves emitted by the regenerative Audion, and which were inductively coupled with the crystal rectifier circuits. Measurements on the amplification values were obtained by means of high resistance coils shunted across a sensitive galvanometer which was used instead of the receiver so that quantitative constants could be determined.

Various curves were shown, indicating the effectiveness of the self-regenerative Audion in its amplification of the received currents as noted by the deflection of the sensitive galvanometer. During the tests a series of measurements were made for the purpose of determining the relation between the maximum signal strength obtainable with a simple electron relay, with separate heterodyne, and again, the signal obtainable when the same relay is supplied with a regenerative circuit and operated as a self-heterodyne. A large number of comparisons were made at a frequency of about 40,000 cycles. The results were extremely irregular due to the very critical nature of the adjustment of the self-heterodyne circuit, but there was found to be an average amplification of about *fifty times* with respect to the signals produced by the externally excited heterodyne.

DARLEY THURNES' RADIO LABORATORY.

In sending radio messages I use a one-inch spark coil, key, gap and helix of my own make; also a glass plate condenser and the necessary batteries and switches.

Mr. Darley Thurnes at His Wireless Receiving Instruments. His Call Is 8 AND.

My receiving is accomplisht with a pair of Brandes' 2,000 ohm 'phones and an 18-inch tuning coil (single slide), fixt condenser, loading coil and four detectors.

With this simple set I am able to hear NAA, NAR, WCX and many of the coast stations. I can also hear all the Amateurs in town. I have a license, my call being 8 AND. I would be glad to exchange photo of my set with other Amateurs.

DARLEY THURNES.

Akron, Ohio.

The entire equipment of a wireless station in Italy which has worked successfully for long distances, including the antennae, is enclosed within a cathedral.

ARLINGTON.

Vesta of younger nations,
Whose flame the old worlds mark,
Mistress of many stations,
That guard the sacred spark—

Tall, from your towered altar,
In speech that links the miles,
You parley grim Gibraltar
Or far Pacific isles!

Carnarvon spoke your minions
E'er had she donned her mail:
The Eiffel's unseen pinions
Pass yours above the gale.

They know your sister greeting
From Charleston, round the Keys,
To Ketchikan, completing
Your circuit of the seas.

Where alien dusks are falling
On beach, or plain, or pine,
They bless your far key calling
In high, staccato whine!

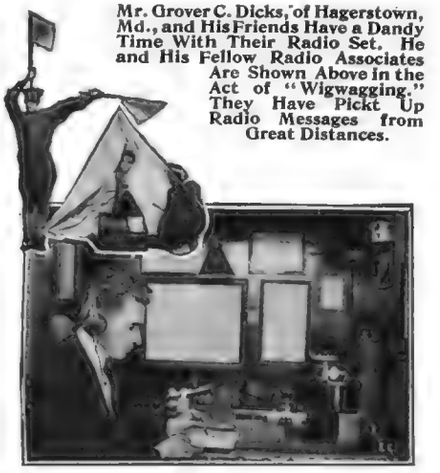
Vesta of younger nations,
From coral-crusted bars,
Or peaks, or bays, your stations
Call back beneath the stars!

KADRA MAYSI.
(New York Times.)

GROVER C. DICKS A RADIO ENTHUSIAST.

The sending set comprises a Gernsback electrolytic interrupter, 1 inch Electro Bull-Dog spark coil, Electro adjustable high tension condenser, commercial spark gap, Murdock wireless key and oscillation transformer.

My receiving set is enclosed in a finely finished cabinet The receiving set consists of E. I. Co., loading coil, Chambers loose coupler, fixt condenser, Crystaloi detector (type A), and Radiograph detector, home-made tuning coil, 28 inches long and good for 9,000 meters on a 75 foot aerial,



Mr. Grover C. Dicks, of Hagerstown, Md., and His Friends Have a Dandy Time With Their Radio Set. He and His Fellow Radio Associates Are Shown Above in the Act of "Wigwagging." They Have Pickt Up Radio Messages from Great Distances.

150 feet high and Brandes' 3,000 ohm receivers.

GROVER C. DICKS.

Hagerstown, Md.

RADIO SET OF K. T. REDICK.

I submit photo of my radio station which I trust will find its way into your *Radio Station* contest columns.

A 1 K.W. Thordarson transformer, five sections of Murdock moulded condenser, a

K. T. Redick Enjoys His Nifty Wireless Set Immensely. Get Him on the Ether, "Bugs"—Call 1 DY.

Murdock oscillation transformer and a Blitzen rotary gap constitute the transmitting set. I have changed the gap so that it will carry the heavy spark of the 1 K.W. transformer.

My receiving set is composed of an Audion, a Murdock loose coupler and a pair of Brandes' receivers.

The high frequency connections in the sending set are kept down to about the minimum of length. Consequently, I have a short, sharply defined wave length even though I have a large aerial. The set is thoroughly up-to-date and does excellent work. My call is 1 DY.

K. T. REDICK.

Newington, Conn.

RADIO STATION AT NAVASSA ISLAND.

A radio station has been installed and is now in operation at Navassa Island light station, West Indies. This station is operated at present by the contractors for the erection of the light station, and it will be operated by the United States lighthouse service when the light station is completed.

U. S. WIRELESS MOTORCYCLE SET SUCCESSFUL.

There is something new under the sun. The army has it.

Out at Fort Sam Houston recently General Funston inspected the brand-new and only military motorcycle wireless outfit.

This latest comer consists of sending and receiving apparatus carried in the side cars of three motorcycles. A dynamo attachment is provided to be run by the engines of the motorcycles. The dynamo furnishes the power for sending messages, and is said to be far superior to the hand-power system that has been in use. Seven enlisted men are required to the outfit.

One of the features is an aerial or tower of hinged steel capable of being raised to a height of forty feet.

Major Walter J. Clarke and First Lieutenant Howard C. Tatum of the Signal Corps are responsible for the motor attachment, they having made extensive experiments.

A tryout was given the motorcycle set by taking it to Boerne and communicating, within just one hour and thirty-three minutes after leaving San Antonio, with the big plant at the Post. The messages sent and received were highly satisfactory. The distance was thirty-three miles and conditions were favorable. It was said that the outfit can be depended on for thirty miles where static conditions are good.

RADIO STATION OF MAYNARD BODLEY.

The accompanying picture shows my wireless station.

The aerial is 74 feet high and 67 feet long and is composed of four strands of copper wire. The receiving set contains a galena detector, a home-made fixed condenser, one loading coil and one 85 ohm 'phone, also a home-made loose coupler.

The sending set consists of a 1-inch coil, E. I. Co. spark gap, mounted inside of the cabinet, aerial switch, key, helix and high-tension condenser.

I obtain very good results with this set and am a steady reader of THE ELECTRICAL

Mr. Bodley Is a Radio Enthusiast and Spends Many Pleasant Hours "Listening In" to the Amateurs and the Big Fellows as Well.

EXPERIMENTER. I think it the best magazine ever put out.

MAYNARD BODLEY.

St. Paul, Minn.

Amateur News

High School Radio Club of Monroe City, Mo.

This club was organized at the beginning of school session, 1915-1916, at Monroe City High School. The club has eight members and the station is located within the school building. The antenna consists of four-strand copper wires, 85 feet long, being 85 feet in height at one end, and 75 at the other.

The sending set comprises a ½-kw. Packard 13,200 volt transformer, oscillation transformer, rotary and fixed spark gaps, condenser and protective device. The receiving set consists of a Navy type loose-coupler, silicon and Galena detectors, loading coil, variable and fixed condensers, and 2,000 ohm phones.

The officers of the radio club are Russell Longmire, president; Harry Longmire, secretary-treasurer; Bert Emerson, chief operator and engineer. All communications should be addressed to the secretary at Monroe City, Mo. The club would like to hear from all nearby amateurs.

Rockaway Radio Club of Rockaway Beach, L. I.

Amateur radio telegraphers in the vicinity of Rockaway, L. I., have succeeded in organizing the Rockaway Radio Club. The following officers have been elected: President, H. Conway; Vice-President, R. Richter; Recording Secretary, L. Wagerer; Financial Secretary, H. Fingerlin; Treasurer, J. V. Byrne; Sergeant-at-Arms, L. Anderson.

For the convenience of the members, a library has been established. E. Richter and W. Byrne were appointed librarians, to take charge of it.

This club, because of its ideal location, has on its roster some of the most prominent in the scientific world. It has for its honorary members such men as Dr. Lee de Forest, L. R. Krumm, chief radio inspector; ex-Police Commissioner J. Hussey; Lawyer F. Davies, and J. V. Byrne and J. Madden, two noted Rockawayites.

Over one-third of the club's members have received first-grade Government licenses. Very interesting lectures are given each week by various members. By the consistent efforts of the instructors, H. A. Conway and R. Richter, new members are taught the code and assisted to obtain operators' licenses.

Some long-distance receiving is also being regularly accomplished. Operator R. Richter has done some excellent work with his oscillating audion set, having succeeded in clearly reading the arc set at Darien, Isthmus of Panama, also the stations at Charleston, S. C., Arlington, Va., and numerous other stations using the arc transmitter. Address all communications to L. Wagerer, 122 Boulevard, Rockaway Beach, L. I.

Roxborough Wireless Association of Philadelphia, Pa.

The members of the Roxborough Wireless Association, which has been but recently organized, are very enthusiastic and the outlook for the club in the future is very bright indeed. The officers elected for the coming year are: President and treasurer, Ernest McGee; vice-president and secretary, Earl Henson.

All communications are to be addressed to the secretary, Mr. Earl Henson, 6200 Ridge Avenue, Philadelphia, Pa.

East Liberty (Pa.) Y.M.C.A. Wireless Club.

Besides the regular wireless club's meeting of the East Liberty Young Men's Christian Association, held at 8 p.m. every Monday night, the club is offering a course in commercial operation and care of a radio station at its headquarters, third floor of the Y.M.C.A., Room "F." This course will be given by a widely known teacher on the subject.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

For further information communicate with the club's secretary, Earl W. Hepner, 450 Morgan Street, Pittsburgh, Pa., or call Bell 'phone "Schenly 1325-W."

Radio Club of Westchester, N.Y.

The Radio Club of Westchester, New York City, was organized recently and holds its meetings at its headquarters, 2320 Newbold Avenue, Bronx, New York City, every Tuesday evening.

The club has installed a ½ K.W. transmitter and a receptor of the loose-coupled type. The call letters are 2 EW. Besides the usual lectures delivered at each meeting, code practice is held thereafter and a most interesting series of lectures is being prepared for the near future. The officers are: President, Herman Buschow; vice-president, Werner Hauptli; secretary and treasurer, Alfred H. Hausrath, Jr.

If interested, write for further information to Mr. Alfred H. Hausrath, Jr., 1866 Cedar Avenue, Bronx, New York City.

Benjamin Franklin Science Class.

On November 11, 1915, a number of "live wire" boys organized the Benjamin Franklin Science Class. The club has established a well-equipped scientific laboratory. At the graduation exercises of the High School the club gave an exhibition on Wireless Telegraphy and Mineralogy. The club anticipates sending in a photograph of its members and laboratory shortly. It is active in the fields mentioned above. Address all communications to Anthony Marino, 511 Traphagen Street, West Hoboken, N.J.

Allentown, Pa., Operators Organize.

At the home of John R. Scholl, 1318 Turner street, a number of amateur wireless operators recently formed a society to be known as the Inter-City Radio Association of Allentown. The organization will be for the benefit of amateur radio operators in this city.

The following officers were elected: John S. Bernhard, president; William J. Kreis, secretary; John R. Scholl, solicitor; David A. Goodling, association inspector. Operators wishing to join the club can get the desired information by communicating with the above.

New Audion Apparatus for Radiophony and Amplifying

A LOW power radio telephone transmitting set for amateur and private installations has just been brought out by Dr. de Forest and is shown in the accompanying illustration. This compact set comprises an oscillation or large Audion tube used as a generator for high frequency currents and may be seen on the front of the panel. It is capable of delivering a sustained wave current of .5 ampere. It is supported on the panel by means of two soft, rubber-covered spring rings. The filament current is obtained from a 12-volt storage battery and is directly controlled from the panel by means of a rheostat stationed at the lower right-hand corner.

The oscillatory circuit consists of a fixed capacity and variable inductance. The two are indicated in the back while the inductance is controlled by means of a multiple switch, shown at the upper left-hand corner. The current passing into the aerial is observed on the hot wire ammeter and the microphone transmitter, which is of unique design, is supported on a movable bracket and is connected in the grid and wing circuit. The exact connections are not at present available owing to patent reasons.

The high voltage current supplied to the wing electrode is obtained from a 500-volt, direct current generator, driven by a motor. This is seen at the left of the switchboard. The dynamo is of special design in order to give an absolutely constant potential of 500 volts.

The complete outfit is extremely compact and light in weight, excluding the motor generator, and is capable of transmitting speech up to twenty miles and more with a suitable antenna.

One of the latest products of Dr. de Forest's laboratory is a unique type of single bulb Audion receiver which performs three distinct functions, viz., it may be used for receiving spark signals, or as a receiver for sustained (undamped) waves, and last, for amplifying the incoming signals. All these functions are performed by this single bulb instrument illustrated herewith.

The Audion is specially built for this kind of work, and is shown at the left of the panel. The filament current is controlled by a rheostat, enclosed in the bottom of the case. The amount of current consumed by the filament is indicated by the ammeter to the right of the Audion.

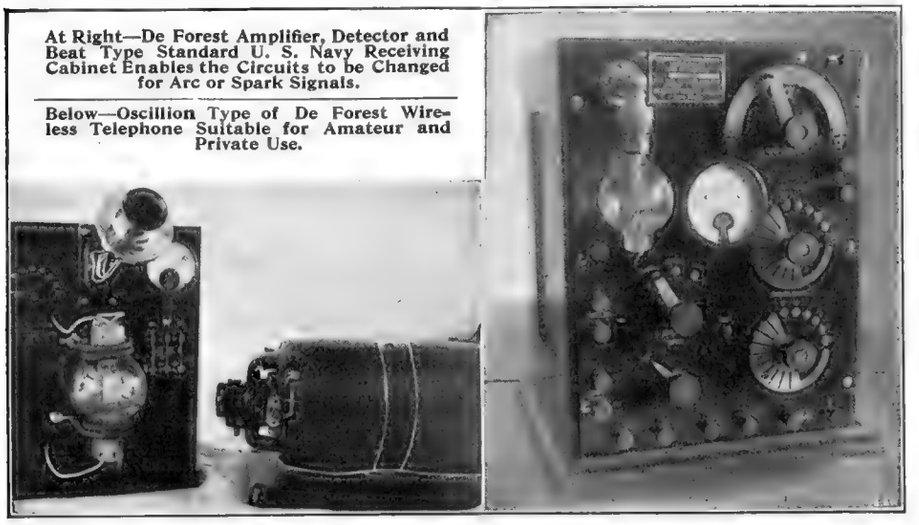
The wing current is regulated by means of a carbon plate potentiometer, which is plainly shown at the upper right-hand corner of the cabinet. The multiple point switch next to the ammeter regulates the capacity of the grid condenser or so-called *stopping* condenser. The lower or bridge condenser switch is connected with a fixt condenser, composed of several sections, which is shunted across the wing and grid electrodes.

The three-point switch beneath the Audion is used for connecting it in the circuit in such a manner as to render it possible to be used as an amplifying receiver for spark and arc stations. This is done by merely placing the switch lever over the proper contact.

The complete unit is of course connected with the regular tuning instruments. This outfit is highly desirable for locations where space is at a premium and also when it is desired at the same time to have available three different functions in the receiving apparatus. The United States Navy has adopted it as the standard.

At Right—De Forest Amplifier, Detector and Beat Type Standard U. S. Navy Receiving Cabinet Enables the Circuits to be Changed for Arc or Spark Signals.

Below—Oscillion Type of De Forest Wireless Telephone Suitable for Amateur and Private Use.



GERMANS "JAM" ALLIES' RADIO.

The Germans have scored a victory in the ether. The *Giornale d'Italia* announces that the powerful sending station in Berlin has been "jamming" the announcements of the Allies and preventing their being received by vessels on the high seas. While unable to jam the powerful Eiffel tower station in Paris, the Germans are successfully jamming the little stations. This is the natural conclusion of the refusal of the Allies to jam the German wireless it is said. This is one branch of the fighting in which the Allies are still content to leave the initiative to their enemies.

NEW WIRELESS STATIONS FOR MONTANA POWER CO.

The wireless station installed by the Montana Power Company near the Rainbow Hotel at Great Falls, Mont., is in daily communication with the station of the company on Spring Creek. Engineer Campbell of the Spring Creek plant has installed the stations after detailed experiments, some of which have produced remarkable results.

The ability to communicate by wireless will prove of great advantage to the company, especially in case of storm, or at any other times when its private lines are out of commission. A saving of considerable money spent for long distance telephone service when its own wires are down, will be effected, it is said, by the wireless.

In Central America there is a large radio antenna supported from a lofty tree.

The Ham What Am

(With all due apologies to a well-known brand)

By Paul Oard.

IN the static room on the hurricane deck,
The work for the day was done;
And the operator yawned contentedly,
And thought of a snooze well won.
In the sea to the West the sun had sunk down,
Marking the close of the day;
So he set his call for the second man
And made ready to hit the hay.

But when he had laid his 'phones on the desk,
Thru the whistling sparks 'long the shore,
There came a call thru the tangled mess,
With a tone twixt a grunt and a snore.
And the call was for him, to his disgust;
The sending switch closed with a snap,
While an angry reply barked from his key
And spread itself over the map.

To his QRA came back the spark
Like shot when it falls in a lake,
And his turbulent thoughts were of that place
Where all good books say we'll bake;
To his startled ear came the answer clear,
In accents of a lamb:
"G E, old man, do you get my spark?
This Am the Ham what Am!"

His current climbed to sixty amperes,
And the ether choked with juice,
In stern rebuke his spark shot out,
Tho he knew 'twas of little use;
And down thru the atmosphere,
From the key of the hopeless ham,
Came back the answer,
"G E, old man, this Am the Ham what Am!"

In the hot engine room three decks below,
The Chief in angry surprise,
Watched the juice race over the board,
And the Ammeters jump to the skies.
Something was wrong, that much he well knew,
But he did not know that the Ham
Was patiently peddling his call through the air:
"This Am the Ham what Am!"

The op'rator's hair stood on end in rage,
Lifting his 'phones off his head,
On the desk he laid them peevishly,
As he thought of his waiting bed;
But as he tost in his bunk,
Thru his dreams of the awful ham
Came this reply to his QRA:
"This Am the Ham what Am!"

EIGHTY SHIPS SAVED BY RADIO FOR FISCAL YEAR 1915-16.

The September number of the *Radio Service Bulletin,* issued by the Department of Commerce, contains a very interesting list of marine disasters in which wireless figured for the fiscal year ending June, 1916.

There are eighty cases cited in the list, and the lives of thousands of persons were saved, all due to the S.O.S. call.

It is quite evident, in looking over this large number of cases of marine disasters that in a very large percentage of them there would have been practically, and without doubt, a total loss of life had it not been for the radio telegraph apparatus carried by them.

In some cases the ship in distress was tost about for many hours before assistance arrived, which makes these annals of the sea all the more extraordinary, as it has not been uncommon for the succoring ship to travel 100 miles or more before it arrived in the vinicity of the distrest craft.

NEW WIRELESS LAW PLANNED.

(*Continued from page 649*)

munication; the words "transmitter" and "receiver" to mean the sending and receiving apparatus, respectively, used in radio communication; the word "radiogram" to mean any message, communication, or signal, transmitted or received in radio communication; the term "radio station" to mean a place where apparatus is used for transmitting, or for transmitting and receiving, the signals used in radio communication; the term "Government land station" to mean any radio station on land, or on a permanently moored vessel, controlled and operated by any department of the Government; the term "Government ship station" to mean a radio station on any ship of the Government controlled and operated by any department of the Government and not permanently moored; and the term "Territory of the United States" or the word "Territory" to mean any Territory, District, Zone, insular possession, water, or other place subject to the jurisdiction of the United States, and not within any State.

The word "person" as used in this Act shall be construed to import both the plural and the singular and to include a corporation, co-partnership, company, or association; and when construing and enforcing the provisions of this Act, the act, omission, or failure of any director, officer, agent, or employee of such corporation, co-partnership, company, or association acting within the scope of his employment or office shall in every case be deemed to be the act, omission, or failure of such corporation, co-partnership, company, or association, as well as that of the person acting for or on behalf thereof.

Sec. 2. Radio stations are divided for the purposes of this Act into the following classes:

1—Coastal station, a station on land or on a permanently moored vessel used for the exchange of correspondence with ships at sea. Coastal stations include (a) those open to general public correspondence, and (b) those open to limited public correspondence. Coastal stations of class (b) transmit and receive public messages to and from certain stations only, which are designated in the license.

2—Station on shipboard, a station on board any vessel not permanently moored. Stations on shipboard include (a) those open to general public correspondence, and (b) those open to limited public correspondence. Ship stations of class (b) transmit and receive public messages to and from certain stations only which are designated in the license.

3—Commercial station, a land station used in the transaction of commercial business and not used for the exchange of correspondence with ships at sea. Commercial stations include (a) those open to limited public correspondence, (b) limited commercial stations, (c) special stations for transoceanic or transcontinental communication. Commercial stations of class (a) transmit and receive public messages to and from certain stations only, which are designated in the license. Limited commercial stations (class b) are stations of private interest, and carry on a specific commercial service or services defined in the license; they do not transmit public messages to, or receive them from, other stations. Special stations of class (c) are open to limited public correspondence or not, as stated in the license.

4—Experiment station, a land station of private interest actually engaged in conducting experiments for the development of the science of radio communication or the apparatus pertaining thereto.

5—Technical and training-school station, a land or ship station of private interest used for purposes of instruction in radio communication and training operators.

6—Amateur station, a land station of private interest not covered by (3), (4), or (5) of this Section, and not operated for financial profit. Amateur stations include (a) general amateur stations, (b) restricted amateur stations, which are within five nautical miles of a Government station, (c) special amateur stations, the operation of which seems likely to result in some substantial benefit to radio communication.

7—Government station, a station controlled and operated by any department of the Government.

Sec. 3. Nothing in this Act shall be construed to apply to the transmission or exchange of radiograms or signals between points in the same State, if said transmission or exchange shall not interfere with the reception of radiograms or signals from beyond the jurisdiction of the said State, or the effect thereof shall not extend beyond said jurisdiction.

Sec. 4. No radio station other than those belonging to or operated by the United States shall be used by any person within the jurisdiction of the United States to transmit any radiogram by the apparatus and methods of radio communication, except under and in accordance with a station license issued by the Secretary of Commerce.

Any person who shall operate any radio station in violation of this Section shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, or imprisonment for not more than one year, or both, for each offense thereafter; and any radio apparatus operated in violation of this Section shall be subject to forfeiture.

Sec. 5. The Secretary of Commerce shall fix the rates charged by all licensed stations open to public correspondence.

The heads of Government departments having jurisdiction over Government land stations and Government ship stations shall, in their discretion, so far as it may be consistent with the transaction of Government business, open such to general public business, and shall fix the rates for such service, subject to the control of such rates by Congress. Such executive heads shall arrange, each in his own department, and for stations under his own jurisdiction, for the transmission and receipt of commercial radiograms between land stations and vessels at sea, between land stations and licensed radio stations within the United States or any territory thereof, and between land stations and radio stations under foreign jurisdiction, under the provisions of the London Convention of nineteen hundred and twelve and future international conventions or treaties to which the United States may be a party. The receipts from such radiograms, less an amount not to exceed twenty-five per cent per annum for the necessary expenses of each department for the handling of such commercial business, shall be turned into the Treasury as miscellaneous receipts.

No radio station other than that belonging to or operated by the United States, or by the Government of the Philippine Islands, shall be operated on land or on a permanently moored vessel in the Canal Zone, or in the Philippine Islands, or in any territory of the United States in the West India Islands other than Porto Rico, or in the Pacific Ocean west of the one hundred and sixty-first meridian of longitude west of Greenwich and south of the fortieth parallel of north latitude.

Every Government land station and Government ship station shall have special call letters which shall be designated and publisht by the Department of Commerce in a list of radio stations of the United States.

Sec. 6. After three months from the passage of this Act and at any time within five years after the expiration of said three months, but not longer, the Government through the Navy Department shall have authority to acquire by purchase at a reasonable valuation any coastal radio station now in operation in the United States which the owner "may desire" to sell.

Sec. 7. The station license required by Section 4 hereof shall not be granted to any alien, nor to any company, corporation, or association of which any officer or more than one-third of the directors are aliens or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof or by any company, corporation, or association organized under the laws of a foreign country; and a license shall become void if ownership or management of the station or apparatus shall be transferred to any alien, or to any company, corporation, or association of which any officer or more than one-third of the directors are aliens or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof or by any company, corporation, or association organized under the laws of a foreign country.

A license shall not be granted if, in the opinion of the Secretary of Commerce, the operation of the proposed station will seriously interfere with the operation of existing Government or licensed stations in the vicinity.

Sec. 8. The station license prescribed by Section 4 hereof shall be issued only in response to a written application therefor, addrest to the Secretary of Commerce, which shall set forth the following facts:

1. The name and address of the applicant, the date and place of birth, and, if naturalized, the date and place of naturalization.

2. If the applicant is a corporation, the date of incorporation and under what laws incorporated, the principal place of business of the corporation, the names and addresses of the officers and directors, a statement as to each officer specifying his place of birth and the country of which he is a citizen, and, if a naturalized citizen of the United States, the date and place of naturalization, and a statement showing what proportion of the capital stock is owned or controlled by aliens, by foreign governments or representatives thereof, and by companies, corporations, or associations organized under the laws of any foreign country.

3. The ownership of the station and apparatus.

4. The exact location of the station.

5. The stations with which it it proposed to communicate.

6. The purpose or purposes for which the station is to be used.

7. The wave-length or wave-lengths which it is proposed to use at the station and the period or periods of the day during which it is proposed to operate the station.

8. The proposed rate to be charged per word.

9. Such further information as the Secretary of Commerce may, by regulation, prescribe.

Every application shall be signed by the applicant upon oath or affirmation. If the applicant is a corporation, the application shall be signed upon oath or affirmation by at least two officers thereof.

(*Continued on page 696*)

THE PLIOTRON OSCILLATOR.

(*Continued from page 654*)

page 250.) For the correct operation of the pliotron as an oscillator it is very important that the potential returned to the grid for excitation has the correct amplitude and phase relation with respect to the plate current. The frequency of the alternating current which a self-exciting system of this type generates will, of course, depend on the electrical constants of the circuits. Various connections have been devised for this purpose. In practice, either one of two general methods is employed, or a combination of the two; that is, sufficient energy is supplied the grid to keep the system oscillating either by electromagnetic or electrostatic coupling. The production of currents of very low frequencies (0.5 cycle per second) as well as those having very high frequencies (50,000,000 cycles per second) are attainable by means of this tube. In this case it is necessary to reduce the inductance and capacity of the circuits to a minimum; in fact, the natural capacity between the elements inside the pliotron bulb is more than sufficient to supply electrostatic coupling between the plate and grid circuits.—*Photo courtesy General Electric Co.*

MOONLIGHT ON TAP.

(*Continued from page 631*)

soft that it lost its shape.

Since moonlight often gives the impression of bright silver, it was decided to try a reflector coated with silver. The result was highly satisfactory and the sought after illusion of a pure white quality of light produced.

All reflectors now in use are made from glass which has been specially treated to resist heat, coated with pure silver. Extremely important is the fact that a constant current of air is forced across them keeping them at a safe temperature; otherwise the heat generated by the bulbs would melt the entire apparatus.

The following principles have clearly been established in producing the illusion of moonlight. White light must be thrown on greens and foliage, otherwise they will appear black; blue light must be cast on white absorbent backgrounds, such as architectural structures, else they will appear flat and lifeless; and iridescent lighting must play on statuary to bring out and accentuate the true beauty of lines and shadow.

The effect produced by the changing, multi-colored lights on the fountain in the inner garden and the urn at the end of the long walk, is something of a mental shock to the beholder; and it was calculated to be just that. It was found that a note of action was needed in the scene to produce a satisfying stimulating effect. The delicate, varying colors with their gradual changes in intensity catch the eye, arrest the attention and thus force the mind to note the unusual loveliness of the entire garden.

CORRECTION NOTICE.

We have to thank Mr. Michael Rozewski, one of our readers, for kindly calling our attention to an error in the article—"Radiation Current in Radio Antennae"—page 495 of the November issue. The logic set forth and the formulae given are correct. However the first example cited for the calculation of the power in watts radiated should read 98.6375 watts instead of 88.6375 watts, and the approximate watts radiated should be 98 watts, not 88 watts. In the last paragraph of the first column—read radiation as 98.6 watts and set 9.8% efficient instead of 8.8 efficient.

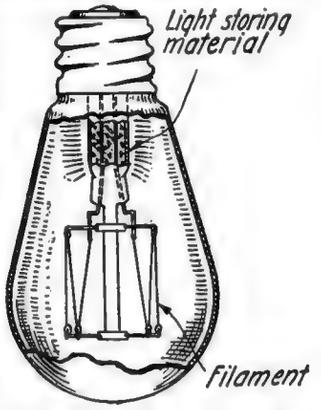
LATEST PATENTS

Luminous Electric Bulb

(No. 1,200,040; issued to James Buckner Speed.)

A very ingenious method of mounting phosphorescent materials within an incandescent electric light bulb. The chemical materials are held in the glass lead-in tube, thru which the filament feed wires pass as indicated. With this arrangement the bulb will give forth a glow for several hours after it has been extinguished, enabling one to readily find it in the dark.

The light storing material may consist of a mixture of powdered glass and some sulfide of calcium or sulfide of zinc. This after-glow illuminating element is therefore



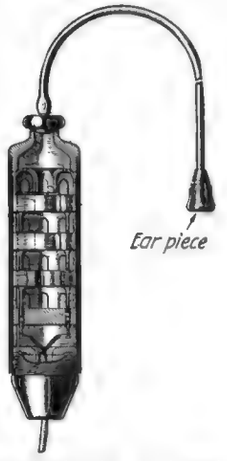
dependent only upon the light given by the filament of the lamp when lighted, and not upon any external source of light.

The function of the glass or quartz granules mixed with the zinc sulfide, is to separate the particles and thus permit the light rays to thoroly permeate the whole mass, thus, of course, raising the effectiveness of the device.

Thermic Telephone

(No. 1,200,470; issued to Piete de Lange and Robert Aernout Baron van Lynden.)

An advanced design in thermic



telephones whereby the heated elements, composed of very fine platinum wire, is not placed within the ear; but instead a number of these heating units are contained in a cylindrical chamber, one above the other, as shown.

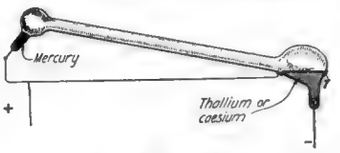
The composite sound effect, resultant from all of the heated wires co-acting, is carried thru a central orifice and out thru a flexible rubber tube to an ear-piece which is placed within the auditory passage of the human ear.

The various filaments are mounted on rings as shown, each ring automatically closing its own circuit as it is placed within the container shell by means of two switch plugs and sockets.

Ultra-Violet Ray Generator

(No. 1,197,629; issued to Peter Cooper Hewitt.)

An improved form of ultra-violet



ray generator resembling a mercury vapor lamp. Mercury is used for the positive pole and thallium or cæsium for the negative pole. These are placed in an exhausted chamber and a starting band (7) is provided at the negative electrode cup. As the passage of current thru the devices vaporizes the thallium or cæsium, this material gives off powerful ultra-violet rays under the influence of the current, which rays may be utilized for various purposes.

In starting, the negative electrode metal being solid, it may be subjected to a momentary high potential or to a source of heat to liquefy it. This action will yield a large quantity of such rays, having a wave length of .000002 to .000004 meter.

Electric Hair Drying Comb

(No. 1,197,872; issued to Aiken C. Taylor.)

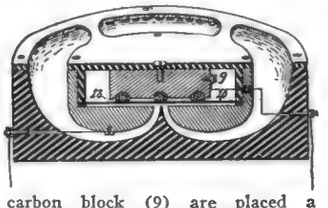
An electrically heated comb for

use in ironing and drying a lady's hair which is provided with extended teeth as shown. The chamber of the comb contains an electrical resistance coil supplied with current thru a flexible cable carried thru the hollow handle. It is intended principally to facilitate the ironing and drying of hair. It is especially designed to be readily taken apart, cleaned and reassembled in a substantial manner. The design is very rugged and the comb may be thoroly sterilized in liquid without danger of wetting the heater.

Sensitive Microphone

(No. 1,201,343; issued to Stephen C. Porter.)

In this improved super-sensitive telephone transmitter, particular attention has been given to the design of the acoustic chamber, so that sounds striking the openings in the microphone will be caused to act integratively on the diaphragm (10) between which and the



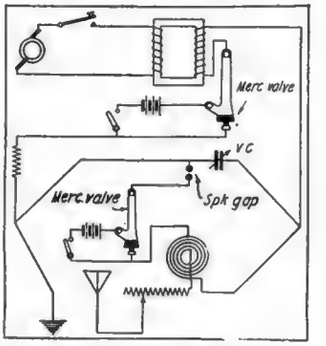
carbon block (9) are placed a quantity of carbon granules, 13.

The sound passage extends all the way around the microphone housing. The instrument is used in connection with an ordinary battery and receiver and is useful in aiding the deaf to hear and for collecting sounds which occur within a reasonable distance off, say, 15 feet away or more. The receiver used with such devices has invariably to be wound to a low resistance—about 6 ohms.

Mercury Valve Radio Transmitter

(No. 1,199,213; issued to Frederick G. Simpson.)

This radio transmitter utilizes a transformer to raise the potential of the primary circuit and the secondary currents are caused to pass in a uni-directional manner thru a mercury valve, as shown. The battery connected to the valve is for the purpose of starting it. The oscillatory circuit discharges from



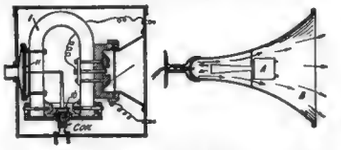
the condenser are also past thru a mercury valve so as to have a uni-directional character.

Thus, electrical impulses of like polarity only can reach the condenser. When the condenser has reached a sufficient potential it will discharge thru the spark gap and second mercury valve to the aerial circuit. By this means a special adjustment of the distance between the spark gap electrodes becomes unnecessary and oscillations in the trigger circuit cannot take place, irrespective of the adjustment or non-adjustment of the spark gap.

Sound Transmitter and Reproducer

(1,201,060; issued to Nathan A. Kurman.)

This invention concerns loud-talking telephonic apparatus, embodying an electromagnetically actuated armature mounted on a right-angled arm attached to a mica diaphragm (11). The iron armature (10) is placed between the pole-pieces of two permanent steel mag-



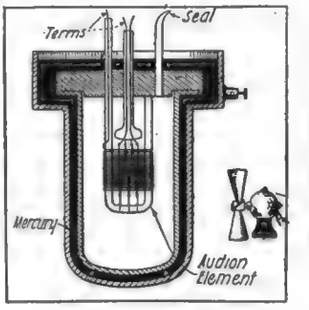
nets 1. The carbon granule microphone of improved design is also mounted in the case as indicated and its electrical terminals lead to binding-posts as well as those of the magnetic coil. This transmitting and reproducing unit is then placed in a large horn as shown at A. Incoming telephonic currents actuate the armature (10) and mica diaphragm (11).

Oscillating Audion

(No. 1,201,271; issued to Lee de Forest.)

Improved means of sealing and conducting heat away from large Audion or Oscillion elements. As shown, the filament, grid and wing of the device are placed within a metal or other container, which rests in a second larger vessel. The space between the two may be filled with mercury, which will effectually seal the interior chamber, permitting a vacuum to be establisht and maintained very efficiently.

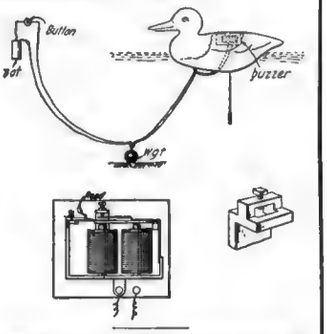
When the vessels are made of metal they may serve as the wing of the Audion.



Electric Sounding Device for Decoys

(No. 1,194,018; issued to Fred Vitus Hartner.)

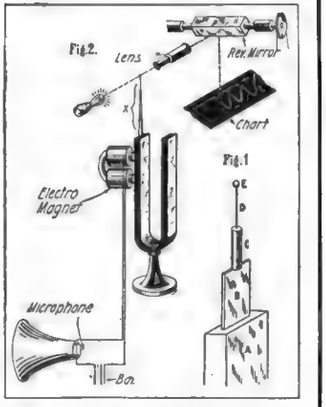
The decoy may be anchored by means of a weight as shown and the lead wires to the battery and push button may be quite long. The pitch of the sound produced by the electric buzzer is variable by means of a tension screw holding the reed, and also by the usual vibrator adjusting screw. Again, the more battery current used, the louder the sound and vice versa.



Oscillation and Vibration Recorder

(No. 1,203,172; issued to Alexander Behm.)

This clever invention involves, in one form, the use of a microphone, battery and electromagnet, which, when actuated by sound waves, will cause the tuning fork and associated vibratory member (X) to oscillate at a certain period. The parts A, B, C and D may be made of glass, surmounted by a ball (E) which in vibrating in the path of



an electric light beam directed thru the lens barrel on to a revolving mirror, as shown, will cause a curve to be traced on the chart.

PHONEY PATENT OFFIZZ

Monthly Prize of $3 for the Best One Submitted

A. MIKE ROBE OF BAKTERIA, N. C.

No. 65 **OTOMATIK FIRE STARTER** **Patent Appaled**

TO WHOM IT MIKE CONCERN:

Be it knowed to all citizens of U.S.A. and other villages, ham-lets & om-lets, as well as outlying planets and asteroids, that, Me and I, assisted by myself, of the illustrious city of Bakteria in the county of Microcokkus, in the State of Nervous Collapse have designed, devised and perfected a revolutionary Otomatik Fire Starter, fully hereinafter to be described

It is a fact too well known to deserve further proofs that since the first days of human cyvylysatyon, man, woman or child has had an instinctive horror towards getting up at 5 A.M. in the early forenoon on a cold-gray morning, with the thermometer so low that it sunk out of sight, in order to light the furnace fire.

Divorce courts are full of cases traceable directly to this cause of husbands (or wives) ejected crudely & cruelly from a warm sleep-emporium into a cold, clammy, chilly gray A.M. to no other purpose than to put a match to the kindling.

All these unnecessary unhappyness, as well as cold and rheumatiz producing horrors have been successfully overcome in my new invention, for which a patent is asked for.

This application furthermore cancels my former application No. 68°X2½% N. Lat. pertaining to my "Quarrel-less furnace Starter" where I proposed to have Husband and Wife shake dice in bed, in order to see who had to get up and light the fire.

This idea proved a rank failure, as I ascertained later, for the simple reason that whenever the female wife lost, she immediately discovered a new & plausible disease or illness which successfully prevented her from getting up just then.

The following constitutes a full description of my present invention:

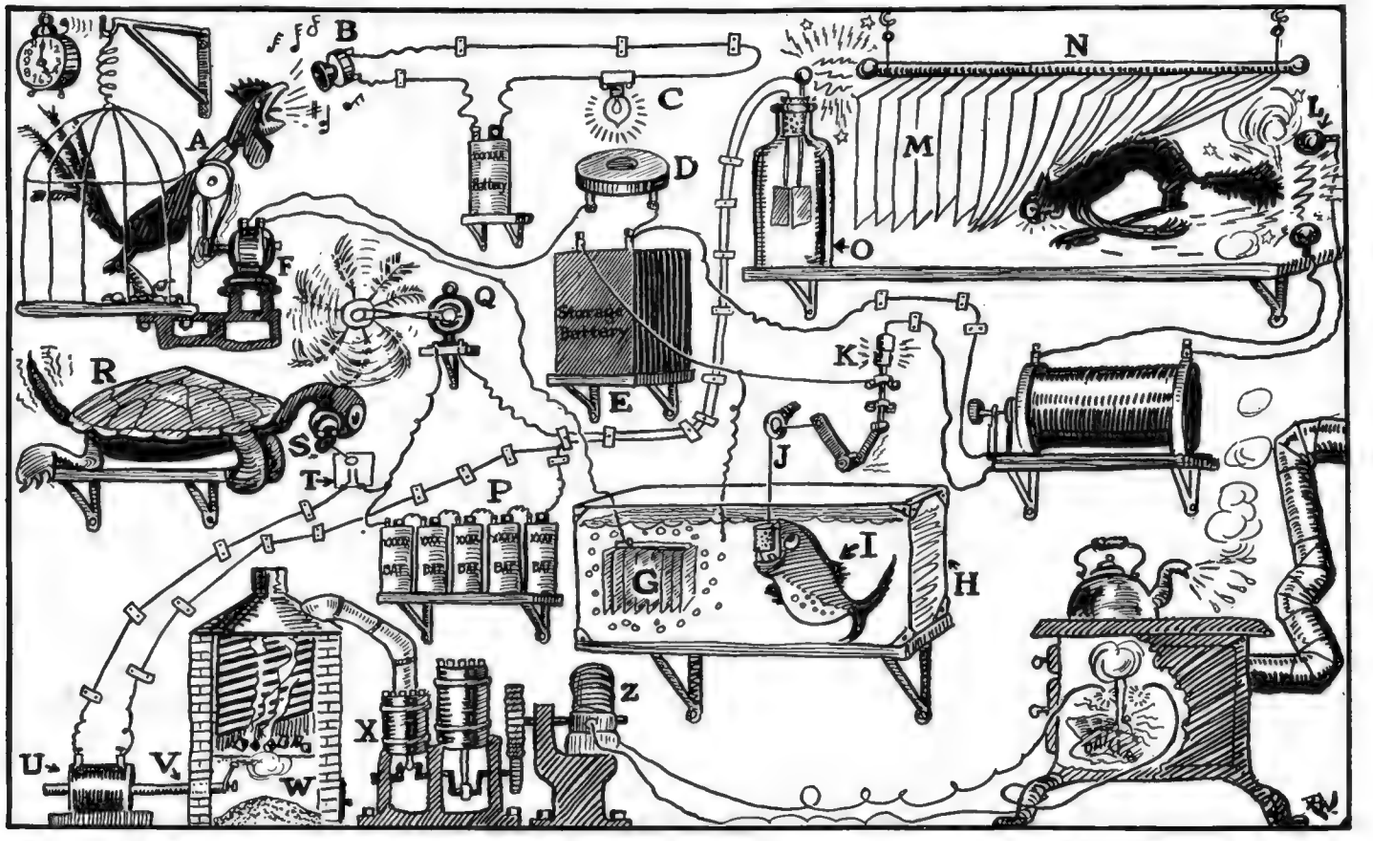
The Bantamoose rooster A, after standing on his corns all night cries with woe in his aching heart at five o'clock sharp. His melodious note affects the microphone B, closing the circuit and lighting lamp C. The light from same operates the Selenium Cell D, causing current from Storage Battery E, to operate motor F, which in turn tightens steel band on rooster's neck and prevents further waste of current in microphone circuit. The reduced current from the motor F, in flowing thru the eight inch platinum plates G, decompose water of aquarium H, containing the rare fish, *Corkfresserus Bitikus,* of South America I. The fish being stimulated by the excess oxygen produced by the current, viciously attacks cork and pulls string J. This operates the switch K, closing Spark Coil circuit. Secondary voltage in relieving itself in spark gap L, awakens cat which has been trained to sleep with tail between electrodes. The cat fearing freezing runs wildly about and under paper sheets M, electrifying same which in turn generates a static current in brass rod N, and thus by inductance operates leaves of electroscope O. This in turn makes batteries P, operate motor Q, whose feathers on shaft tickle snapping turtle R. Snapping turtle gets peevish and bites meat S, thus operating switch T and energizing solenoid U. This draws the rod V, causing match in firebox W to scrape on file and ignite fuel under boiler. As soon as enough steam is generated it works compound Corliss Valve engine X, which in turn runs Webster Magneto Z. Spark from this ignites gasoline soaked paper protruding thru conveniently constructed hole in stove and the fire is lit.

What I claim is:

1° A Painless otomatik Fire Starter.

2° An Otomatik Furnace Starter requiring no male or female profanity for starting it.

3° A Furnace Starter successfully employing all house pets, to keep them in daily trim.



Behold a Most Welcome and Timely Invention, the Electrical Method "De Luxe" for Automatically Lighting the Kitchen Fire These Cold Winter Mornings. It Is Indeed Remarkable for its Simplicity.

In Fitness whereso off I have heretofore & hereinafter sat down on my seal my hyroglifs from now on unto all other time & forever thereafter, this 39th Night after the 38th day with the barometer at 786% Humidity central time of the year Anno Domino 12 A.C. at 689 Meters Wavelength in the Shade.

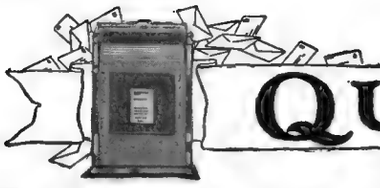
A MIKE ROBE

Fitnesses: *By his Attorney*

Si Multanous *Jos. Prochasky*

Al Uminnum *Chicago, Ill.*

Q Kumber



QUESTION BOX

This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

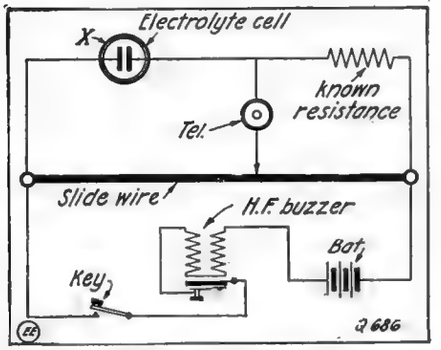
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

RESISTANCE OF ELECTROLYTES.

(686.) P. Jolson, Salem, Oregon, asks:

Q. 1. Please give me a diagram of connections for the measurement of the resistance of electrolytes.

A. 1. The diagram herewith shows the



Using Special Bridge and Buzzer Method for Measuring Resistance of Electrolytes.

connections of a Wheatstone bridge for the measurement of resistance of electrolytes. It should be remembered that when a current flows thru electrolyte it is accompanied by a composition of substance in solution. The positive ions move in the same direction as the current, while the negative ions travel in the opposite direction, each being liberated at the electrodes. In some solutions, this action causes polarization which tends to oppose the flow of current. In order therefore to measure the resistance of an electrolyte, it is necessary to employ an alternating current. It can readily be obtained from a small H. F. buzzer connected as shown herewith.

The electrolyte is placed in a suitable cell and made the fourth arm of a Wheatstone bridge. An induction coil or buzzer is used in place of the usual battery. The resistance of the electrolyte can then be determined by the bridge method in the usual way. Since an alternating current is employed, the balance can be found by means of a telephone receiver connected in the usual place for the galvanometer. For the purpose of instruction the best form of cell for holding the electrolyte is a cylindrical tube with a circular electrode closing each end. The resistance measured by the bridge is then the resistance of the electrodes and knowing the resistance of this column of the electrolyte the resistivity of this solution can be calculated the same as a metallic conductor or is equal to:

$$S = \frac{R \times A}{L}$$

WHERE:—A equals the cross-section of the tube containing the solution and L is the resistance between the two electrodes.

Q. 2. Is it possible to use any other means for exciting the Wheatstone bridge?

A. 2. You can employ either a buzzer or a high frequency alternator ranging from 500 to 1,000 cycles for excitation.

TUNING OF RADIO TRANSMITTER.

(687.) Edward Law, Jr., Clarksburg, W. Va., desires to know:—

Q. 1. Detail for the use of a hot wire ammeter and wave meter to test a radio set composed of the following: 1 K.W. Clapp-Eastham type "E" transformer giving 4000 volts; condenser composed of 9x12 inch glass plates; rotary spark gap (speed 8000 R.P.M.); oscillation transformer, protective device, key and aerial. Please explain how to tune this station. The aerial is composed of four strands of No. 14 copper wire, 60 feet high and 180 feet long, of the inverted "L" type.

A. 1. In regard to the tuning of your transmitter, and the various pieces of apparatus, the wave meter should be placed according to the diagram given herewith. In tuning the transmitter to a particular wave length, it is necessary at first to set the wave meter at the desired wave length which the set is to emit. Then by exciting the transmitter and at the same time watching the wave meter, the clips of the oscillation transformer are adjusted until the intensity of signal in the wave meter receiver is at maximum. At this point the transmitter is emitting a wave corresponding to the wave meter setting.

How the Wave Meter Is Employed for Checking Up Radio Transmitting Set.

The current intensity of the transmitter is determined by inserting a hot wire ammeter in series with the ground lead as near the earth as possible. By adjusting the coupling of the oscillation transformer, a point is reached where a maximum radiation current is obtained. The hot wire ammeter is generally used for indicating the maximum radiation current.

AERIAL QUERY.

(688.) R. C. Hudson, Minneapolis, Minn., asks the following:—

Q. 1. Would it be better to bring my four aerial leads in, twisted together, direct to the instruments or the four leads in for about 15 feet and then solder them to a No. 8 single copper wire?

A. 1. It is usually advisable to connect the lead-in rattails near the antenna and bring a single lead down to the instruments.

Q. 2. What is the wave length of a four-wire aerial, 100 feet long, 45 feet high, with the wires spaced 2 feet apart?

A. 2. The maximum wave length of your aerial is 260 meters.

Q. 3. How far could I send with the following: A 1 K.W. Thordarson transformer (new type); a rotary gap running at 6,000 R.P.M., an oil-immersed condenser of 1 K.W. size and a Murdock hinged-type oscillation transformer—the whole set being connected with short leads of ¾ inch copper ribbon and operating on the above-mentioned aerial?

A. 3. You should have no trouble in transmitting 150 miles with favorable weather conditions and suitable aerial.

We would also advise you to reduce the speed of your rotary gap as we think the discharge of the condenser might be irregular, due to the high speed of the gap, thus resulting in unsatisfactory results from your transmitter.

RADIO RECEIVING HOOK-UP.

(689.) Verne Van Vlean, Lodi, Cal., desires:

Q. 1. A hook-up for the following instruments: loose coupler; Morehead tube; three variable condensers; fixt condenser and 'phones.

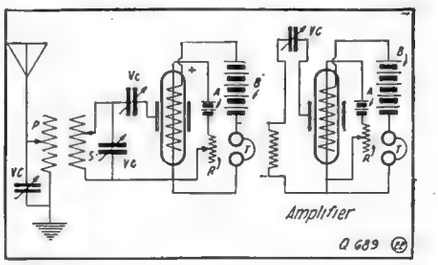
A. 1. The diagram herewith shows the connections for the instruments which you have.

Q. 2. Give hook-up for Morehead tube as an amplifier and state which mineral is best in this arrangement.

A. 2. The diagram herewith gives the connections of the Morehead tube used as an amplifier. We would advise you to employ galena for a detector crystal. It has been stated already in these columns that *Radiocite* crystal gives far better results than any other crystal known and we would advise you to make a test with it.

Q. 3. What is a variometer used for? In which circuit is it most important—sending or receiving?

A. 3. The variometer is an inductive coupling device used for tuning radio sending or receiving sets. It consists usually of two coils, placed one within the other and electrically connected together, the ends of the coils being connected in series with the tuning circuit. Their mutual inductance is variable by changing the position of the inner coil or both. The coefficient of the

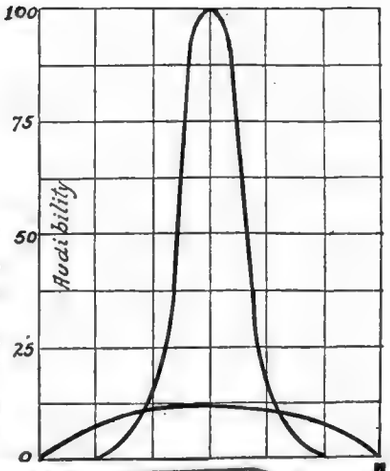


Hook-up for Morehead Tube Used as Radio Amplifier.

coupling of the variometer is very high and for this reason it is very desirable as a tuning device. Practically zero mutual inductance can be obtained with this device.

(*Continued on page 676*)

NOTE THAT PEAK



THE peak is what you get on a RA-6 regenerative receiving set—100 times amplification. The lower curve is the response you get on an ordinary set.

Just imagine the amplification—100 times—and the selectivity is just as great as the amplification. No damping in that peak signal, no interference even if that other station is on the same wave. When you get that peak, you are getting all there is to get out of any incoming signal.

How many times have you had a signal fade out, and tried everything under the sun to hold it just a second or two longer? Then study that peak. Note the difference—see all the strength of signal you have to spare over the strength of signals over an ordinary set.

How about the stations you have never heard? Stop worrying because the fellow with the big aerial hears them and you don't. That peak will bring them in. The RA-6 will give you that peak.

This instrument is super-efficient, super-selective and super-sensitive. It was designed especially and solely for reception of **AMATEUR-WAVE LENGTHS** and its development has been carried on over a period of two years. It was the FIRST and is the ONLY worthy adaptation of the Regenerative circuits to short-wave reception. The antenna inductance is arranged in steps. **ASIDE FROM THIS THERE ARE NO SWITCHES.** Continuously variable inductances—carefully designed variometers are used in the closed circuits. **HIGH RESISTANCE CONTACTS, the capacity of switch points and leads, end-turn losses and the necessity for a variable tuning capacity are thus ENTIRELY DONE AWAY WITH.**

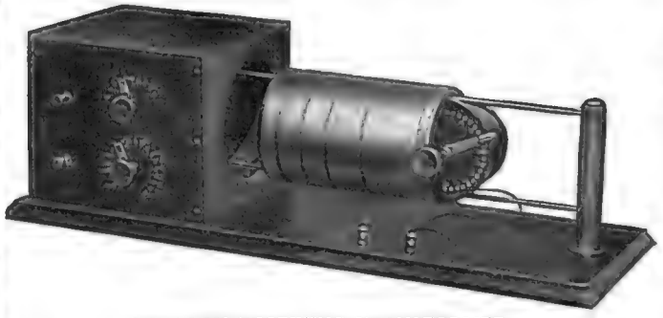
The antenna and closed circuits are INDUCTIVELY COUPLED and the COUPLING IS VARIABLE. The component parts of the instrument are not crowded into a small cabinet. The fact that ALL of these things are of extreme importance has been proven by the here-to-fore unheard-of **SELECTIVITY** and **AMPLIFICATION** obtained by owners of this instrument. Signals may be read from stations at extreme distances or through heavy static and interference with this instrument long after other receivers have failed, and WEAK SIGNALS MAY BE AMPLIFIED UP TO **ONE HUNDRED TIMES USING ONE AUDION ONLY.**

The RA-6, price $35, is as perfect mechanically as it is electrically. It is made right. Everything used in it is the result of long trial and experiment, to make a short-wave set that would give the greatest possible response to any incoming signal, on 180 to 580 meters.

Make that peak work for you ***now***. Write us ***now***.

R.A.—6—PARAGON AMPLIFYING SHORT-WAVE RECEIVER, $35.00
Range 180 to 580 Meters

PARAGON WIDE RANGE RECEIVING TRANSFORMERS



PARAGON RECEIVING TRANSFORMER
TYPE "L" $22.50 TYPE "S" $30.00 TYPE "X" $35.00

The methods employed in winding the coils eliminate leakage due to coloring matter in the insulation, put an end to the presence of moisture in the varnish, insulation and tube. The coils of the Paragon **"No-End-Loss"** transformers are divided into sections and fitted with **self-cleaning, positive-action** end-turn switches which connect and disconnect the winding as required, **entirely cutting off from the circuit** unused portions of the inductance and **completely eliminating end-turn effects on all wave lengths.** These switches are enclosed and are automatically controlled by the primary and secondary inductance switches respectively.

Panels, housings, switch heads, etc., are of polished black FORMICA, which is superior in every way to hard rubber and costs more. All metal parts are of gold lacquered brass. These instruments are adapted to extremely close tuning and due to the absence of end-losses are particularly recommended as the only receiving transformers on the market suited to the reception of amateur wavelengths or for use in conjunction with the AUDION-DETECTOR.

LOADING COIL
For long wave work **$8.00**

Paragon Instruments Have Set New Standards

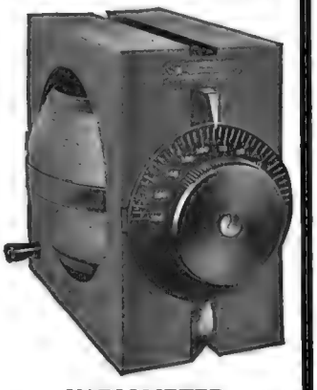
They are in a distinct class by themselves. There are no other instruments which can EQUAL THEM IN ANY WAY—regardless of price. WE CAN PROVE THIS ASSERTION TO THE SATISFACTION OF ANYONE.

SEND STAMP TODAY FOR BULLETIN "O" WHICH DESCRIBES A VARIETY OF ENTIRELY NEW TRANSMITTING AND RECEIVING SPECIALTIES OF PARTICULAR INTEREST TO THOSE WHO DESIRE THE BEST.

Send 6c. for our 232 pp. Catalog

Our No. 7 Catalog shows several hundred different parts and also sets of materials for building your own apparatus. We do all the difficult work in our factory and give you the benefit of machinery and equipment.

Contains complete description and prices of all the latest Wireless and Electrical Goods.



VARIOMETER
Wound for any range. A necessity for the proper tuning of the Audion circuits on short wave lengths. $9.00

OUR PRICES WILL SAVE YOU MONEY AND OUR PROMPT DELIVERIES WILL SAVE YOU TIME

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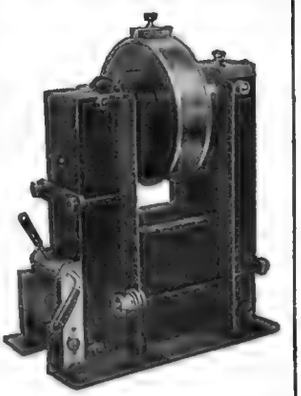
"Talking a Thousand Miles"
is no extraordinary feat for the owner of the new
THORDARSON
WIRELESS TRANSFORMER

The superior range, power and flexibility of this new model justifies our statement that it is the "Best One 1 KW. Transformer Ever Designed." Twenty years of patient experiment by C. H. Thordarson, the "Transformer Wizard", have resulted in developing the most perfect transformer ever designed for amateur use. Indeed, it is widely used and praised by professional operators. Its exclusive Variable Shunt and Ampere Scale make it wonderfully accurate in obtaining resonance. Comes completely assembled—no chance for mistakes or burnouts. Five sizes, ½ to 2½ kw., 10,000-20,000 volts, any cycle desired.



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EUGENE T. TURNEY CO., Inc.
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SEND five cents in stamps for this new catalog which contains cuts and descriptions of the following Wireless Receiving Apparatus: New Turney Wireless Telephone Receivers, Vario Variable Condensers, Loose Couplers, regular and navy types, Tuning Coils, Loading Coils, all types of Crystaloi Detectors, the New Flat Switch Point, Special Turney Tubular type Audion Bulbs and much other valuable information.

This is not only a splendid catalog, but a work of art.

LEARN WIRELESS

At the largest, best equipped and ONLY practical Radio School in New England. ENDORSED BY GOVERNMENT AND MARCONI OFFICIALS. Last year we placed *EVERY* graduate in good positions in all parts of the world, and still we are unable to fill the demand. Complete course in 6 months. Day and evening classes now forming. Easy payments if desired.

Send stamp for new fall prospectus

899 B BOYLSTON STREET EASTERN RADIO INSTITUTE BOSTON, MASS.

QUESTION BOX.

(*Continued from page 674*)

FEDERAL STATIONS.

(690.) E. E. Griffin, San Diego, Cal., inquires:—

Q. 1. Does the Federal Telegraph Company's station at South San Francisco send any press reports with their arc? If so, at what time and on what wave?

A. 1. As far as we know, the station operating at South San Francisco sends press reports, but we are not informed as to the time they transmit. According to latest reports it is said they operate at a continuous stretch during the twenty-four hours. The wave length is 3,000 meters and higher.

Q. 2. At what time and on what wave does the Naval station at San Diego send press on their arc set?

A. 2. The Naval station at San Diego usually sends press at noon on a wave length of 8,000 meters.

Q. 3. Are there any other stations on the Pacific Coast that send press on spark sets besides Marconi?

A. 3. We do not know of any other aside from the Marconi stations.

GENERATOR VOLTAGE FORMULA.

(691.) Alfred Hanson, of Brownsville, Texas, wishes to know:—

Q. 1. A method by which he can calculate the voltage of a magneto generator.

A. 1. The formula herewith gives the means by which you can calculate the voltage generated by your machine.

$$E = \frac{4SVI}{60 \times 10^8}$$

where

E=Voltage

S=Number of conductors on armature

V=Speed of armature in R.P.M.

I=Total flux density in Maxwells (in this case 30 Kilo-Maxwells per pole × two or number of poles).

Q. 2. How would you determine the electro-motive force of a magneto generator which contains 1,760 turns on the armature, and is revolved at 1,200 R.P.M.? The magnetic field was tested by a magneto-mometer instrument and showed an intensity of 60 Kilo-Maxwells. Kindly give proper substitution in the formula if you have any.

A. 2. The solution of the problem is given below:

$$E = \frac{4 \times 1760 \times 1200 \times 60{,}000}{60 \times 10^8}$$

E=84.48 volts.

Q. 3. What is meant by impedance?

A. 3. Impedance is the total counter effect in an alternating current circuit—that is, it includes resistance and reactance, which latter term includes the capacity reactance and inductive reactance. These three terms when combined have a certain counter or opposing effect upon an alternating current. This total effect is called the impedance. There are several impedance equations which are applicable to different forms of alternating current circuits and we would therefore refer you to some modern text-book on the subject of alternating current listed in our Book Catalog, supplied free.

ALTERNATING CURRENT PROBLEM.

(692.) L. Boyer, Montreal, Canada, states as follows:—

Q. 1. In figuring out the volt-amperes of a three phase, three wire A.C. circuit for the purpose of subsequently calculating the power factor, should three ammeters be used; or is it sufficient to have two ammeters connected in the two outside legs of the circuit only?

(*Continued on page 678*)

AMPLITRON The New VACUUM DETECTOR AMPLIFIER OSCILLATOR

DESIGNED BY AUDIO TRON ENGINEERS

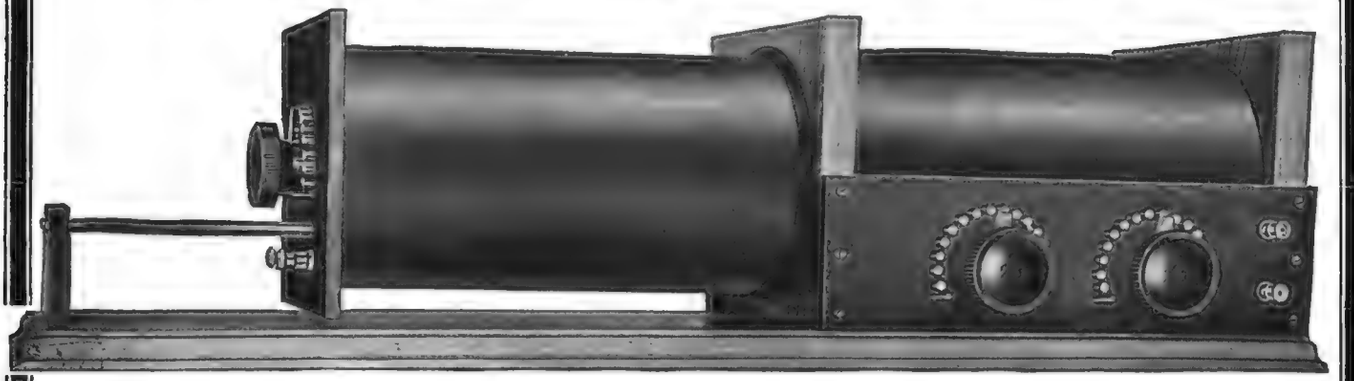
More Powerful Amplifier, More Persistent Oscillator than the Audio Tron

This detector is of the two-member external control type and was originated by Audio Tron Engineers last April. It has been developed and greatly improved since that date. This is its first public offering.

Special Introductory Price **$5.25**

AUDIO TRON ALWAYS OFFERS GREATEST MONEY VALUE WHEN YOU BUY ON SPECIFICATION—NOT ON INDEFINITE DESCRIPTIONS

$32.50 AUDIO TRON 15000 M. ULTRA LOOSE COUPLER **$32.50**
Special Introductory Price on orders mailed before January 1st



Embodies best features of commercial engineering practice. Quarter sawed oak base and primary ends, secondary end, primary panel and guide support hard rubber. Lathe-turned fiber tubes. No enameled wire used. 16 taps on secondary, 32 on primary. Navy bearing type switches. Large knobs. All metal parts nickeled. Windings covered with black celluloid gives rich appearance and insures protection. Length overall, 36". Primary ends, 11" square. Double secondary guide rods. Guaranteed to tune to 15,000 M. The only high-grade long-wave coupler at any price. Regular price **$37.50.**

Orders mailed not later than January 1st will be shipped at these Special Prices:

AUDIO TRON No. 1 Junior Receiving Panel

No. 1 B Panel, Tube and 30 cell sealed B battery	$14.85
No. 1 A Panel and Tube	10.50
No. 1 Panel only	7.00
Parts for Panel only	5.00

Fully Guaranteed.

Shipped prepaid when cash accompanies order.

Maple Panel finished in black imitation Bakelite. Potentiometer Control. All metal parts nickeled. Double Cut-Out Switch. Genuine double filament tested Audio Tron.

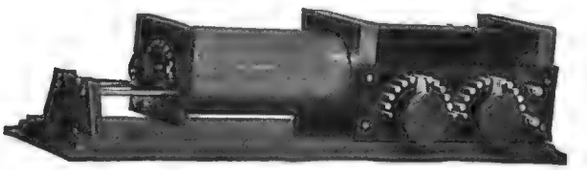
Brackets for Table Mounting.

This High Grade Navy Coupler—$14.90

Delivered Free—on orders mailed before January 1st.

Quarter sawed oak, base and primary ends. Secondary end, primary panel and guide support hard rubber.

Metal parts nickeled.



AUDIO TRON Navy Type Coupler, $17.50

Navy type bearing switches. Large knots. Fiber tubes, lathe cut. No enameled wire used. Windings covered with celluloid. Double guide rods. Tunes to 3000 meters.

TERMS: Free Delivery where cash accompanies order. Satisfaction guaranteed.

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FREE Delivery If You Send Cash With Your Order

Nauen, Germany
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Undamped signals were recently received over this great distance by the DHE Station at Pittsburgh, Penn.

Holtzer-Cabot **RADIO PHONES**

were used. Nothing special; simply our Standard Set, no amplifying device in circuit.

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THIS ILLUSTRATION SHOWS one of the many new articles brought out especially for the wireless trade.

A. C. VOLT AND AMMETERS
PRICES
VOLTMETER—O to 125 Volts - - $8.50
AMMETER—O to 10 Amperes - - $8.00

MAGUIRE & SHOTTON
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THE NEW TUBULAR MICA CONDENSER

Composed of a special mica possessing infinitesimal leakage. Its efficiency permits use across your tuners in place of massive load coils, to raise wave. Use in place of your present fixed condenser and note quality of tone and amplification. Made in two capacities, one capacity for grid of audions and tubular detectors, and one for crystal detectors. Individual capacity marked on same, tested from standard furnished by Bureau of Standards. Specify purpose. A high efficiency, beautifully finished permanent condenser, guaranteed. **Postpaid $2.50 Each.**

MONOTONE
IMPROVED QUENCHED GAP

Are you a leader or follower in adopting up-to-the-minute efficient apparatus? Equip your station with the famous MONOTONE IMPROVED QUENCHED GAPS, which are a big improvement over the original MONOTONE GAP. Span that freak distance on powerful waves of RADIO ENERGY. Each plate carefully machined. Best mica. Adjustable. One unit of the new gap for spark coils up to 3". One unit for every ¼ K.W. power of transformer. Specially recommended for powers below ½ K.W. Parts nickled and polished. You will be pleased with this new gap. Guaranteed. **Postpaid $2.50 Each.**

THE RICHARDSON CO., Manufacturers of Radio Apparatus **ERIE, PA.**

QUESTION BOX.

(*Continued from page 676*)

A. 1. In alternating current circuits where the power factor is to be determined, especially in polyphase circuits, it is usually advisable to have three ammeters connected in the circuit so as to take a simultaneous reading. This is necessary as the current and voltage lag or lead relations in polyphase circuits are of such a character that they may vary in the course of a few seconds or minutes.

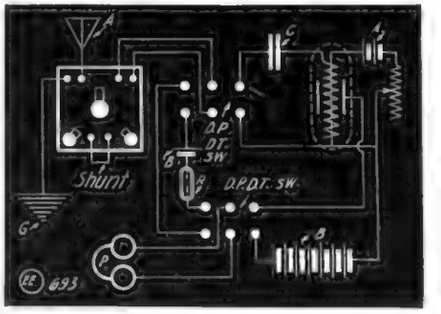
Q. 2. If it should be absolutely necessary that 3 ammeters be used; why is it that with polyphase wattmeters the current from the two outside legs only passes thru the meter?

A. 2. Because in the 3 wire, polyphase circuit of a compensated wattmeter, the coils are so adjusted that the true watts and not the apparent watts are measured. The three voltmeter or three ammeter method is little used in practice as it involves a considerable error unless the constants of the circuit are accurately known and special precaution taken to take the three readings simultaneously.

RADIO QUERY.

(693.) Henry Roberts, Yonkers, N.Y., requests a hook-up for the following apparatus:

Q. 1. An E. I. Co., Vario-Selective coupler, rotary variable condenser, fixt variable condenser, junior fixt condenser, 2000 ohms Transaltantic 'phones and Radioson



Connections for E. I. Co., Vario-Selective Coupler Using Either Radioson or Tubular Audion.

detector, all their make, together with Audiotron bulb detector.

A. 1. The diagram herewith gives connections of instruments which you ask for.

ANTENNA LEAD-IN.

(694.) Beauford Bailey, McAlester, Okla., writes as follows:—

Q. 1. If the leads of a sixty-foot aerial are connected about twenty feet from one end, will two different wave lengths be sent out when transmitting? Or will there be the same effect as if the leads were connected to the center?

A. 1. It is advisable in your case to connect the lead-in rattails at the center, as it may cause annoyance to distant stations due to a harmonic wave resultant from the arrangement which you describe. When we speak of a harmonic wave, we mean a secondary wave emitted by the transmitter in such a way that it will overpower the natural wave of the transmitter, thus causing an annoyance to other stations which is absolutely prohibited by the United States radio law. With a proper quenched Gap set, however, this may be eliminated as the higher harmonic can be distorted by detuning it.

Q. 2. If one cannot have aerial and ground leads both short, would it be better to have a long aerial lead?

A. 2. It is advisable to employ a long aerial lead with a short ground lead.

(*Continued on page 680*)

Wireless Apparatus MESCO of Known Quality

MESCO Short Wave Regenerative Receiver

Recommended for relay work on wave lengths of 180 to 450 meters. It is possible to receive wave lengths up to 1,000 meters with reduced amplification.

The circuit is the Armstrong regenerative with constants accurately calculated for the wave lengths when employed in conjunction with audion detectors.

Will receive undamped and damped waves.

No. 8467—MESCO Short Wave Regenerative Receiver.....Price **$32.50**

Will increase receiving range of any station over 100 times.

Complete in every detail and ready for operation when connected to an aerial ground audion detector and telephone receivers.

A blue print of connections with detailed instructions for setting up and operating this receiver is supplied with each instrument. Oak cabinet.

The metal parts are of brass, nickel polished.

Intensifying Transformer

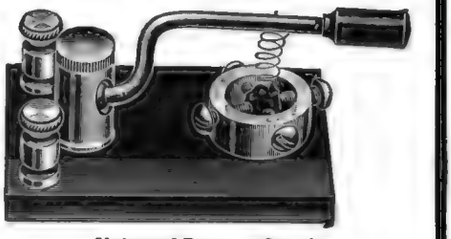
Can be used with any crystal detector in connection with Audion. Signals can be intensified 10 to 25 times.

No. 224.....Price **$12.00**

Variable Condenser

Capacity .001 M. F. a thoroughly reliable and scientifically made instrument.

No. 294.....Price **$4.00**



Universal Detector Stand

Remains permanently in adjustment. One of the most simple and effective Detector Stands made.

No. 248.....Price **$3.00**

Fixed Receiving Condenser

For stationary and portable outfits. Diam. 2½ in. Base removable and can be screwed to table. Large capacity.

No. 440.....Price **$0.83**

Wireless Practice Set

The most perfect set made. Equivalent to five different sets. Supplied complete with Red Seal Dry Battery.

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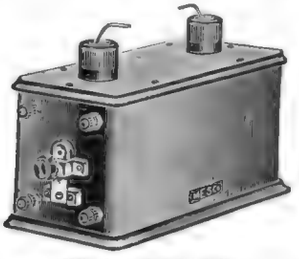
Wireless Key

The last word in efficient wireless key construction.

No. 452—N. P. Lever.....Price **$1.98**



Wireless Spark Coil

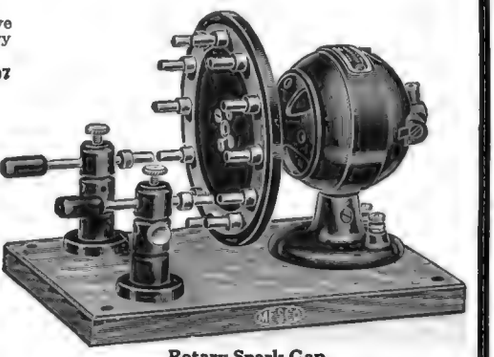
Unquestionably the best on the market today. Best coil to use on Dry Batteries as the consumption of current is very low. Made in ¼-in. to 4-in. The 3-in. and 4-in. supplied with separate primary condenser.

No. 495—3-in.....Price **$21.00**
No. 496—4-in.....Price **$34.80**

Telephone Receivers

Very high grade. Can be used on 2000 miles. Extremely sensitive. 1000 ohms.

No. 480.....Price **$6.00**



Rotary Spark Gap

Will increase the efficiency of any Transmitting Station 20 to 30 per cent. Has very high clear note. Can be used on spark coils or transformers up to 1 k.w. capacity.

No. 222—6v.....Price **$12.00**
No. 223—110v.....Price **$13.00**

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The most complete book of its kind published. You cannot possibly afford not to have one. Contains 180 pages. Send for one NOW.

YOU WILL GET YOUR 10 CENTS BACK ON AN ORDER FOR $1.00

Our Pocket Electrical Catalogue W28, 248 pages, mailed on request. This catalogue contains practically everything in general use in the electrical line and is in fact a small pocket encyclopedia of electrical goods information.

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114 S. 5th Avenue - Chicago **MANHATTAN ELECTRICAL SUPPLY CO., Inc.** 1106 Pine Street - - St. Louis
604 Mission St., San Francisco

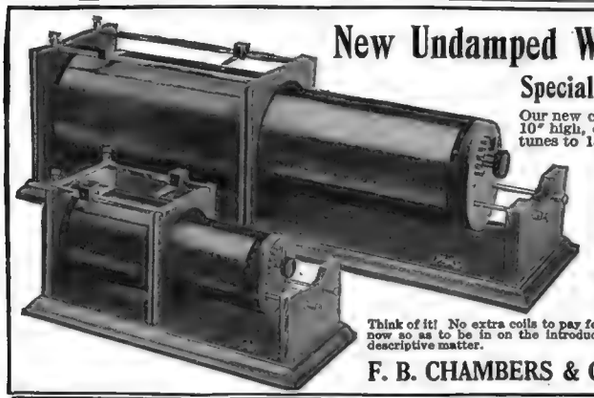
INCREASE YOUR SENDING RANGE 200 TO 400 MILES

We sell hundreds of these transformers to wireless operators.
Let us tell you how to save money by using this unmounted transformer in building your outfit.

Wireless Transformers

The Packard Electric Company — Warren Ohio

Write for Wireless Bulletin E. E. Full of valuable information



New Undamped Wave Coupler No. 749

Special Introductory Price, $18.00

Our new coupler No. 749 is 32" long, 9" wide, and 10" high, over all, and on an average-sized Antenna tunes to 15,000 meters. This coupler, used with the new CHAMBERS' SYSTEM or CIRCUIT, will bring in signals from domestic and foreign Arc Stations surprisingly loud and clear. Note the difference in size of our No. 748 and No. 749.
We claim to be the original inventors of a SYSTEM or CIRCUIT for the reception of the undamped waves without the use of Loading Coils or Oscillating Coils, as they are sometimes called; as with our SYSTEM or CIRCUIT only two Inductively Coupled Coils are necessary. Circuit supplied with each coupler.
This CHAMBERS' CIRCUIT saves you money.
Think of it! No extra coils to pay for, and price of coupler only $18.00. Place order now so as to be in on the introductory price. Orders filled in rotation. Send for descriptive matter.

F. B. CHAMBERS & CO., 2046 Arch St., Phila., Pa.

"THERE'S MONEY IN IT"

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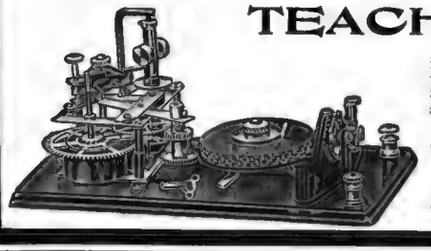
MORSE AND WIRELESS

TEACH YOURSELF



in half the usual time, at trifling cost, with the wonderful Automatic Transmitter, **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

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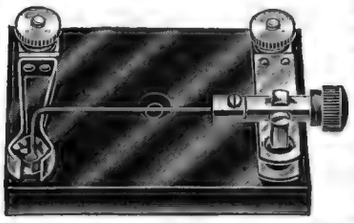
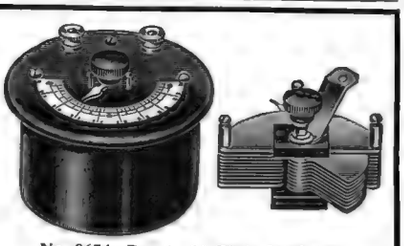
Use Bunnell Apparatus



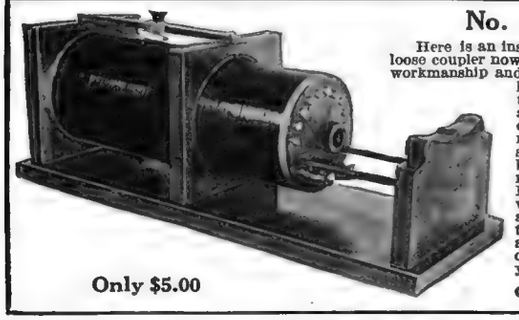
Best and mostdurable. Up-to-date dealers have them in stock. Our Catalog 36E illustrates and describes about 300 articles of wireless apparatus as well as other appliances. Send 2c stamp for it, to

No. 8804 Jove Crystal Detector Holder
On Dark Porcelain Base . . . $1.20
On Handsome Composition Base . . . 1.50



No. 8654 Dandy 21 Plate Variable Condenser $3.90

J. H. BUNNELL & CO.'S
Radio Dept.
32 Park Place New York



No. 2 LOOSE COUPLER

Here is an instrument which, although low in price, excels any loose coupler now on the market. It is first-class in appearance and workmanship and works as all good instruments should. Wavelengths well above that used by N. A. A. in sending time may be reached with this instrument as well as the neighboring amateur. Do not think that because the price is low the quality is also, for such is not the case. We are told by amateurs who have seen and used this instrument that it surpasses in both appearance and efficiency many loose couplers now on sale at 3 times what we ask for this one. Instrument made of maple and wound with enamel wire on seamless, non-shrinking tubes. Size over all 6 x 6 x 18 inches. Shipping weight 15 lbs. But this isn't all; we've got a Navy Type at $12. that's a dandy; variable and fixed condensers; loading coils, detectors, etc. Send 2c. stamp and see what you've been missing.

Only $5.00

CLIFF. MFG. CO., BROOKFIELD, MASS.

QUESTION BOX.

(*Continued from page 678*)

Q. 3. If the slider on the primary of a loose coupler makes contact with more than one turn of wire at a time, would it have any weakening effect on the incoming signals?

A. 3. Yes, it has a weakening effect upon incoming signals, as a number of turns are short-circuited by the slider.

THE DIFFERENCE AS TO WHO MAKES THE "MISTAKE."

When a PLUMBER makes a mistake he charges twice for it.

When a LAWYER makes a mistake it's just what he wanted, because he has a chance to try the case all over again.

When a CARPENTER makes a mistake, it's just what he expected, because chances are ten to one that he never learned his trade.

When a DOCTOR makes a mistake, he buries it.

When a JUDGE makes a mistake, it becomes the law of the land.

When a PREACHER makes a mistake, nobody knows the difference.

But when an ELECTRICIAN makes a mistake, he blames it on *induction*, because nobody knows what that is.

RADIO DETECTOR DEVELOPMENT.

(*Continued from page 652*)

its own battery when a carbon or zinc cup is used, as this forms a miniature cell—carbon (or zinc) acid, platinum. This inherent battery action was intensified considerably by using a special amalgam in the acid solution in a detector of this class developed by H. Gernsback several years ago. The self-excited electrolytic detector has never been found (Pierce) to be as satisfactory as the externally excited one for feeble oscillations.

Another form of electrolytic detector which will stand considerable rough usage is that known as the *Sealed-Point Electrolytic Detector*. The commercial form of this instrument, as here illustrated, is known as the *Radioson*, Fig. 7. The operation is the same as in the bare-point electrolytic type of detector and a battery of two dry cells is used with it, together with a pair of high resistance telephone receivers and having the battery potential preferably regulated by means of a high resistance potentiometer.

The advantage of this type of electrolytic detector is that the acid is sealed in, consequently does not spill or evaporate.

A detector of novel design and termed by Professor Fessenden, its inventor, a *Barretter*, is shown at Fig. 8. This works on the heat or thermal principle. An extremely fine platinum wire, about .003 inch in diameter, was first embedded in the middle of a silver wire having a diameter of about one-tenth inch. This compound wire was then drawn until the silver wire had a diameter of about .002 inch; as the platinum wire within it was reduced in the same ratio, it would be drawn down to a final diameter of .00006 inch. As shown in the illustration (Fig. 8), a short piece of this extremely fine platinum wire is supported on two heavier silver wires, and the leads are taken out thru the outer glass bulb for the purpose of connection in the radio receiving circuit. The tip of the fine platinum wire loop had previously to be immersed in acid to dissolve away the silver before the whole device was finally sealed up and the air exhausted from the containing bulb.

When an oscillating electric current flows thru the extremely fine platinum wire loop it becomes heated and rapidly increases its electrical resistance. A number of these

(*Continued on page 689*)

GIFT SUGGESTIONS

CRYSTALOI

A Permanent Detector of Great Merit

OVER 10,000 IN USE

TYPE O, $3.50

OTHER TYPES TO $12.00

The Eugene Turney Co., N.Y. City
Gentlemen: The Crystaloi Detector arrived the other day and I have given it a severe test. Needless to say I have discarded all other Detectors. If any one should ask me what I consider to be the most sensitive Detector I would not hesitate to say 'The Crystaloi,' for with it I have heard things that I have never heard before. I am, &c.,
JOHN B. DOWDEN,
Sept. 12, 1916. Glen Cove, N.Y.

Eugene T. Turney Co., Inc.
New York City.
Dear Sirs: Just wrote you to show what can be accomplished with a Crystaloi type AA when properly operated. I have obtained results that are equal to those that a friend of mine obtained using Vacuum Valve Type Detector. I have copied amateur stations located in Ohio 8AEZ. Mich. 8AOI, Ill. 9AC, Ohio 8NF, also 9XE, NAJ, NAA, 9ZS, WPT. This is only a small number compared to what I have actually copied. Sincerely,
CHAS. W. HAVENLA,
Nov. 4, 1916 Cedar Rapids, Ia.

THE NEW TURNEY HEAD SET

With Adjustable Pressure Head Band

Shipping Weight 1 lb.

Price $7.50

Patent Applied For

Made to U. S. Navy Specifications

FOUR NEW FEATURES

Three thousand ohms	Bakelite ear-caps
Flexible back support	Consequent pole pieces
Positive friction adjustment	Soft, clear tone
No screws to catch the hair	Weight nine ounces
German silver head band	Can you beat it?

THE TURNEY VARIO VARIABLE CONDENSER

Front View

Scale Readings

SCALE 1-0 to .001 M. F.	SCALE 4-0 to .00012 M. F.
" 2-0 to .0005 M. F.	" 5-0 to .00007 M. F.
" 3-0 to .00025 M. F.	" 6-0 to .000055 M. F.

SCALE 7-0 to .000035 M. F.

Dimensions 6x6x3 **Price $10.00**

Shipping Weight 3 lbs.

For extreme measurements such as WAVE METERS, REGENERATIVE CIRCUITS and the like this Condenser has no equal. It is seven complete Condensers in one. It is especially valuable as a grid circuit Condenser. Owing to the sky rocket prices in material and labor we were obliged to increase the price of this instrument to $10. Get our new catalog, it tells all about it.

CONSTANT AMPLITUDE TEST BUZZER

Dimensions 2¼" x 2½" **Price 90 cents**

Postage 10 cents

OVER 12000 SOLD

Our special Constant Amplitude Test Buzzer contains some entirely new features and closely resembles the tone of a 500-cycle Telefunken set. This is due to the arrangement of the contact which is provided with a lenient back-check which prevents the armature from over-reaching and the amplitude becomes constant. This you will find in no other Buzzer. The contact points are of pure silver which prevents burning and the entire mechanism is enclosed in a non-resonant dielectric case. You will never know you have a Buzzer in your circuit as far as attention is concerned. It is provided with three binding posts and is highly finished.

Eugene T. Turney Company, Inc., 2595 Third Avenue NEW YORK CITY

Trans-Atlantic Receiving

A Minneapolis, Minn., wireless amateur (name on request) writes about his success with our head set as follows:
"I will say that I have found them (Improved Type A-9723) far superior to anything I have tried before. They have a quality of tone that speaks for itself. I can get O.U.L. Hanover, Germany; W.A.S.; N.B.A.; K.H 8.; and other arc stations with regularity and clearness using your phones."

STROMBERG-CARLSON RADIO HEAD SET

You will probably find this improved type A-9723 Radio Head Set—wound to 2000 ohms at your dealer. If not, we will send it direct for $8.25. Keep it ten days. If it does not do all that we claim for it, if not satisfied that it is the best buy on the market, send it back and we will refund money without question.

Send for Bulletin No. 1006-C giving full description.

Stromberg-Carlson Telephone Mfg. Co.
Rochester, N. Y.

EXPERIMENTERS!!
WE SPECIALIZE IN
SEAMLESS CARDBOARD TUBING
IN SIZES SUITABLE FOR
TUNING COILS, LOOSE COUPLERS, TESLA COILS, Etc.

SPECIAL GRAY TUBES
18"x6½"x6⅛" $1 ea. 18"x7½"x7⅞" $1 ea.

PRICE LIST
Smooth Wound Wireless Tubes

Outside Diam.	Lgth.	Price	Par. Post
3	x 7½	.12	.18
3½	x 7½	.12	.18
4	x 7½	.15	.22
4½	x 7½	.20	.27
5	x 7½	.25	.31
5½	x 7½	.25	.33
6	x 7½	.30	.37

GENERAL INFORMATION
These prices include PARCEL POST CHARGES: and are shipped at once on receipt of order and remittance.
We CANNOT furnish these tubes in longer lengths than 7½" unless ordered in quantities of 100 of a size.
We CAN furnish SPIRAL WOUND TUBES in any length up to 45 inches at .02 per inch in the following inside diameters, 3½-4-4½-5-6.

BEETLE & MACLEAN MFG. CO.
21 BROMFIELD ST. BOSTON, MASS.

A New and Remarkably Efficient
QUENCHED SPARK GAP
—FEATURES
Absolutely silent.
Capacity ½ K.W. per section.
Voltage—10,000 volts per section.
Positively won't arc or pit.
Construction—All metal.
Insulating Ring—Bakelite.
Size—3 in. diameter.

Price $5.00 per section prepaid

You should try this gap

ROSENTHAL LABORATORIES
Camden New Jersey

THE PRESIDENTIAL AMATEUR RADIO RELAY.

(Continued from page 648)

8ACK, Russell Blair, Norwood, Ohio, 245 sigs. Chock full of grit.

5CW, H. L. Ansley, Birmingham, Ala., 213 sigs. Our little southern brother.

Commercial stations that were called QRM by a great many stations who were trying to pick up the MSG—WHB, NAO, NAI, WRU, NAJ, WGO, WUF, WGV, WNU and a few others.

Amateur and special stations that were called QRM by many amateurs—8YO, 5AM, 2AGJ, 2DA, 4CL, 9TZ, YJ, 9XN, 6BJ, 5ZC, 9nn, ION, 9AKH, 9KU, 9UN, 8XA. There is a possibility that a great many of these were not read correctly and our apologies are offered to those that are not guilty.

The First Prize

The one K.W. new type Thordarson transformer offered by the Thordarson Electric Mfg. Co., of Chicago, is still safe at last reports. Kenneth Briggs, of Rochester, N.Y., and J. N. Simpson, of the same city, were on the watch and had located Mr. Charles Evans Hughes at the Hotel Seneca in that city. As soon as each of them received the MSG, he went with all speed to the hotel and Mr. Briggs evidently arrived first. He relied on the clerk to give the MSG to Mr. Hughes, and the clerk (dodgast the luck) forgot it. Mr. Simpson arrived soon after and the clerk told him that someone else had been there ahead of him, and he left without verifying it. Both these young men had a good chance and will probably always remember that hotel clerks are in a class by themselves. A later letter from another amateur states that a dandy fire escape outside of the building would have permitted both of them to hand the MSG to the presidential candidate and give him the surprise of his life. We will hold this prize till later and maybe some one will be more lucky on the next relay.

Stations that received the MSG and checked the mistakes are given below. Each credit means that this station checked the mistake from one certain station, and the ones with six, for instance, checked six different stations.

8NH—Mr. and Mrs. C. Candler, St. Marys, Ohio, 6 credits.
9MK—E. H. Giddings, Lanark, Ill., 6 credits.
9DK—D. H. O'Neill, St. Louis, Mo., 5 credits.
9ADT—G. Hartman, Wauwatosa, Wis., 5 credits.
8AEZ—M. B. West, Lima, Ohio, 5 credits.
4DI—W. S. Rothrock, Winston Salem, N.C., 5 credits.
8ALE—Alexander Bros., Grove City, Pa., 4 credits.
9IK—H. G. Mathews, Chicago, 4 credits.
Chester Sinnett, Bailey Island, Me., 3 credits.
9FW—K. B. Warner, Cairo, Ill., 3 credits.
1IZ—R. T. St. James, Great Barrington, Mass., 3 credits.
DK—Kent Bros., Dewitt, Iowa, 3 credits.
9WS—Coy V. Patterson, Kansas City, Mo., 3 credits.
9KF—J. A. Goorisich, Chicago, Ill., 3 credits.
9ACO—E. Wittick, Moline, Ill., 3 credits.
7YS—St. Martin's College, Lacey, Wash., 2 credits.
9RD—F. M. Bailey, Clinton, Iowa, 2 credits.
8CO—H. W. Harmon, Grove City College, Pa., 2 credits.
2ZB—W. L. Brooks, Schenectady, N.Y.
5OX—D. Simmons, Shreveport, La., 2 credits.
7D—H. W. Blagen, Hoquiam, Wash., 2 credits.
3RD—R. Dimling, Baltimore, Md., 2 credits.
9HQ—D. R. Terry, Stoughton, Mich., 2 credits.
6SI—L. L. Hoyt, Hayward, Cal., 1 credit.
3RO—W. T. Gravely, Danville, Va., 1 credit.
IZF—H. C. Bowen, Fall River, Mass., 1 credit.
9VS—Parker Wiggin, Kansas City, Mo., 1 credit.
3ST—R. R. Chappell, Richmond, Va., 1 credit.
3GX—G. C. Robinson, Richmond, Va., 1 credit.
6PN—Paul Nesbit, Acampo, Cal., 1 credit.
3ZS—C. H. Stewart, St. Davids, Pa., 1 credit.
9YE—W. S. Ezell, Wichita, Kan., 1 credit.

(Continued on page 685)

ENCLOSED ROTARY GAP

Run it with your motor
Any Speed--Any Tone

The Gap runs in a cast iron housing and is silent in operation.

One Movable Contact Insuring Close Adjustment

MOUNTS IN ANY POSITION

10% discount on orders received by ***Jan. 10th***

½ K.W. $8.50
1 K.W. 10.00

J. HERBERT FERRIS
211 Catalpa Drive
Royal Oak Mich.
Prompt Shipments

Voice Thrower

Learn to throw your voice into a trunk, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, the Janitor, Policeman, or Friends.

The Ventrilo

is a little instrument that fits into the mouth out of sight. Boys or Girls can use it. NEVER FAILS! A 32 page book on **Ventriloquism** sent with the **VENTRILO** for **10Ct**

Royal Novelty Co.
Dept. 38 SO. NORWALK, CONN.

Did You See Page 702?
Then show it to your best friend. Thanks.

EXPERIMENTERS
When you buy radio apparatus see that
FORMICA
the best electrical insulator made, is used in its construction
Now used by
Clapp Eastham Company
De Forest Radio T. & T. Co.
Electro Importing Company, etc.
Full information from
THE FORMICA INSULATION CO.
CINCINNATI, OHIO

BOSTON WIRELESS
Rotary Condenser, 43 plates, .001 M.F., $3.75
Tuner, $2.50. Spark Gaps, 60c. and $1.00
Detectors, $1.00, $1.75, $4.00
Loose Coupler, $7.50, 1500 Meters
Agent for A. W. Bowman & Co., Adams-Morgan Co. Manhattan Spark Coils. Catalogue for 2c. stamp.
M. MUELLER, 18 Devonshire Street, BOSTON, MASS.

A USEFUL MODERATE PRICE GIFT
"Vulcan" $1.00 Ink Pencils

Non-leakable, suits any hand. Guaranteed, last a lifetime. For all writing. Para rubber, precious metal point, can be carried point down. Red and black, long and short. (Special 3 inches, black, $1.25.) Mail orders with FREE supply of inks promptly filled. Agents wanted. J. R. ULLRICH & CO., 27 Thames St., N.Y.

MULTIFORM RECEIVER

The Multiform Receiver is positively the last word in the wireless world. It combines that long looked for receiving set which brings together on a single panel a straight Audion Circuit, the Regenerative Circuit and the Un-Damped Circuit for the reception of long wave stations.

The Multiform Receiver is so constructed that the operator may instantly pass from 150 meters to 15,000 meters by simply throwing a switch, and he may also at his will cause the bulb to oscillate at any point.

With the use of the Multiform Receiver the three Radio functions of the Audion Bulb—Rectification, Amplification and Oscillation—are utilized to their highest possible capacity.

Size 24" x 16" x 12" in mahogany, with Bakelite panel, price.....$100.00.

M.A.F. Short Wave Regenerative Attachment

Our new Multi-Audi-Fone Short Wave Regenerative Attachment is so constructed that you can connect it with your Audion and loose coupler and get those long distance relay messages. Your receiving range will be increased one hundred per cent on a wave range of 150 to 2,800 meters.

Large coils may be added for the reception of un-damped stations.

Our M. A. F. Short Wave Regenerative Attachment is in panel form, built on a genuine Bakelite panel, and the workmanship is of the highest grade throughout.

Size 8"x12" Price $22.50

Buy Your Audions From Us

Send for "Multiform Receiver" and "Regenerative Attachment" Circular

JUST PERFECTED BY THE

MULTI-AUDI-FONE

The Best Wireless Christmas Present

The best wireless Christmas present of all wireless instruments is the Multi-Audi-Fone. If you don't believe it read what some of our users say--

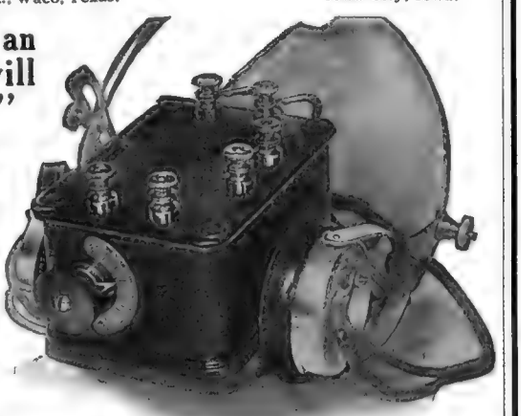
R. B. TENNEY says: "Gentlemen:—The Single Step Multi-Audi-Fone is doing wonders and instead of waiting for the few stations I was able to get before I purchased this I can listen in at any time. I can hear dozens of stations I could never hear before. It certainly is all you claim and has made my wireless outfit a double source of pleasure. Yours very truly,
R. B. TENNEY, JR., Waco, Texas."

R. C. GIESE says: "The other night I heard Un-damped signals at the end of a one hundred and fifty foot hall and four and one-half stories above my station. We get Arlington or Springfield all over the room day or night.
R. C. GIESE,
Iowa City, Iowa."

"If you ever use an M. A. F. you will always use one."

Multi-Audi-Fone -	$18.00
Two-Step M.A.F. -	75.00
Multiform Receiver	100.00
M. A. F. Detector Stand - - - -	4.25
Pocket Wireless Set	5.75
Detectorfone - -	35.00

Send for Circular



MULTI-AUDI-FONE
275 MORRIS AVENUE
ELIZABETH, N. J.

PRICE, $18.00

TRADE-MARK
LENZITE
REGISTERED

LENZITE CRYSTAL DETECTOR

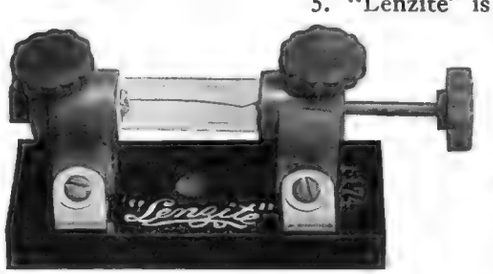
Patented May 2nd, 1916

A first class Wireless Detector is half the battle in the wireless game. Have you tried the best and most effective, **The "Lenzite" Crystal Detector?**

Why Is Our Detector Near Perfection?

1. "Lenzite," the new mineral substance, is acknowledged by leading authorities to be the best substance yet discovered for wireless detectors.
2. "Lenzite" is absolutely superior to any other electrolysis detector combination.
3. "Lenzite" is more economical than most others.
4. "Lenzite" is the most simple detector to manipulate.
5. "Lenzite" is the easiest to adjust and holds the adjustment better.
6. "Lenzite," although not permanent, is the only substance that does not lose its efficiency or effectiveness through excessive charges or excessive heat. In fact, it improves with such treatment.
7. "Lenzite" can be handled like any other crystal, no special care being necessary.
8. "Lenzite" is used exclusively in our detector and comes direct from our mines and is not purchased from different places.
9. "Lenzite" has the endorsement from Q. S. T., the official organ of the American Radio Relay League.

If you want to have a perfect receiving detector, try ours. If not satisfactory, return same within thirty days and we shall be pleased to refund you the price.



Send money order, express order or check for **$5.00** and we will send you, postage prepaid, one of our Lenzite wireless detectors.

LENZITE CRYSTAL CORPORATION
537 Chamber of Commerce Building Pasadena, California

YOU can build the most efficient Radio Detector known to radio science at a very moderate cost. That is a Moorhead Tube and one or more electron relays in cascade. This combination possesses merits that no other known device can equal. The Moorhead Tube is used as the detector and the electron relays as amplifiers. The highest possible sensitiveness combined with absolute stability and freedom from static or stray interference on short or long waves is accomplished with this device. We are manufacturing a new amplifier coil that enables you to connect all the filaments to one storage battery.

A recent test by Dr. B. N. Burglund of San Francisco, using a Moorhead Tube and one Electron Relay enabled him to copy the German stations, five feet away from the fones in daylight.

We manufacture this set designed by Dr. Burglund on a bakelite panel containing one Moorhead Tube, one Electron Relay, all necessary High Class Switches, two sets of Plate Batteries, and ready to install.

The Price Complete is	**$35.00 prepaid**
Our Special Amplifying Coil	**9.50 prepaid**
The Moorhead Tube	**6.50 prepaid**
The Electron Relay	**5.00 prepaid**

Write for Our Circulars on These Tubes

PACIFIC LABORATORIES SALES DEPARTMENT
534 PACIFIC BUILDING, SAN FRANCISCO, CALIFORNIA

MIGNON SYSTEM

SUPERIOR MIGNON SYSTEM RADIO APPARATUS

THE LAST WORD IN RADIO ENGINEERING

Mignon Adjustable Disc Core Undamped Wave Receivers

RW 1, RW 2 and RW 3

THESE RW TYPES (latest Mignon invention) are entering a new field in Radio Engineering, eliminating the so familiar Loose Couplers and Loading Coils. These late types introduce adjustable special metal disc cores, heretofore considered absolutely impossible. These new undamped wave receivers are the most efficient apparatus constructed at the present time, regardless of price and manufacture.

Write for Catalog R7 and mention E. Ex.

MIGNON WIRELESS CORPORATION, ELMIRA, N. Y. U. S. A.

THE PRESIDENTIAL AMATEUR RADIO RELAY.

(*Continued from page 682*)

6AS—Eric Austin, Sacramento, Cal., 1 credit.
2AGJ—J. K. Hewitt, Albany, N.Y., 1 credit.
6WS—W. Ford, San Diego, Cal., 1 credit.
6SR—R. O. Shelton, San Diego, Cal., 1 credit.
1UN—J. W. Peckham, Middleton, R.I., 1 credit.
5DU—B. Emerson, Dallas, Tex., 1 credit.
3WL—R. Davis, Washington, D.C., 1 credit.
6TQ—A. Emerton, Sawtelle, Cal., 1 credit.
3QZ—C. A. Service, Bala, Pa., 1 credit.
9FA—L. A. Walker, St. Joseph, Mo., 1 credit.
8CM—K. Briggs, Rochester, N.Y., 1 credit.
7ZC—A. C. Campbell, Lewiston, Mont., 1 credit.
5CQ—Ray Atkins, Groesbeck, Tex., 1 credit.
9IC—G. A. Greenleaf, Woodstock, Ill., 1 credit.

These stations received the MSG, but forgot to check mistake.

6DM—Robt. Higgy, Phoenix, Ariz.,
1EAA—T. H. Gavin, Fall River, Mass.
8AAK—C. R. Pardridge, Saginaw, Mich.
5BV—J. M. Clayton, Little Rock, Ark.
9TZ—J. A. Gardner, Eureka, S.Dak.
9TZ—E. R. Isaac, Eureka, S.Dak.
9RW—H. J. Pourhop, Sheboygan, Mich.
1DX—S. Sandreuter, Stamford, Conn.
9ZL—Cecil Bridges, Louisville, Ill.
J. T. Moorehead, Greensboro, N.C.
J. N. Simpson, Rochester, N.Y.
R. Ray, Park Rapids, Mich.
F. Jameson, Leavenworth, Kan.
B. Emerson, Monroe City, Mo.
S. D. Daraley, Jacksonville, Ill.
W. L. Galloway, Xenia, Ohio.

There were hundreds of others who merely stated that they had received the MSG and did not state from *what station* and *did not check mistakes.*

The following is the list of sending stations that worked on the relay and also the stations that read them and checked their mistakes:

9XR—heard by 9LP, 9PY, 9NY, 9JT, 9FW, IZF, 9RD, 9WS, 9VS, 9ACO, 9ZL, 9FA, 9IC, 9LW, 8AOZ, 9IK, D.K., 2AGJ, 9KF.

9YA—heard by 9LP, 9MK, 9YE, 9NY, 9JT, 9FW, 5DU, 9RD, 9DK, 9WS, 9ACO, 9FA, 9TZ, 8ACK, 9IC, D.K., 9GY.

9ZS—heard by 9LP, 9PY, 9MK, 9NY, 9JT, 9FW, 8AAK, 9RD, 9WS, 9VS, 9ACO, 9ZL, 9FA, 8NH, 9LW, 9IC, 9ACM, 9IK, 5OX, DK, 2AGJ, 9GY, 9KF.

9IK—heard by 9BJ, 9NY, 3RO, 9JT, 9FW, IZF, 8NH, 9DK, 9ZL, IDX, 8ACK, 3ZS, 9ADT, 9LW, 3RD, 8ALE, 9IC, 9KF.

9ADT—heard by 9IK and 8NH. There seemed to be a fading from this station this night.

7ZS, 7DJ, 7YS. All heard each other and if you will refer to the map you will see what great distances were covered.

9BD—heard by 9MK, 9JT, 9FW, 8NH, 9RD, 9DK, 8ACK, 9LW, IIZ, 9IC.

8JZ—heard by 4DI, 9JT, 9FW, 8NH, 9RD, 8ACK, 8ALE, 5BU, 8CM, 9IK, 2AGJ, 9GY.

8ADE—heard by 8NH and 9IK, but the latter station said that his sigs. were faint.

8SK—heard by 9BJ, 9ADT, 8NH, 8ALE, IIZ, 8ARB, 2ZB, 9IK, 2ALI, 9GY.

9ZF—heard by 9LP, 9ADT, 9MK, 9JT, 9FW, 9RD, 9VS, 7ZC.

8YI—heard by 9BJ, 9LP, 8ALE.

8AEZ—heard by 9BJ, 9LP, 9FA, 3RO, 4DI, 9JT, 9FW, 8NH, IZF, 9MK, 9MY, 9NY, 9RD, 9GY, 9DK, 8AAK, IUN, 3RD, 8CO, 9ADT, 8ALE, 3ST, 3GX, 5BU, IIZ, 9IC, 2ZB, IASI, 9IK, 9ACM, 5CW, 9LW, 8ACK, 2ALI, 4CK, 3QZ, 9HQ, 8QG.

2ZB—heard by 8YI, 8NH, 9RD, 9IC.

9QF—heard by 9LP, 9MK, 9RD, 9VS.

8NH—heard by 9BJ, 9LP, 9NY, 3RO, 4DI, 9MK, 3RD, 8AAK, 9RD, 9DK, 8ALE, 8CO, 8QG, 9IC, 5BU, IIZ, 8ACK, 8AOZ, 9IK, 5CW, 9GY.

9ABD—heard by 9BJ, 9LP, 9ADT, 9MK, 8NH, 8ALE, 4DI, 9RD, 9DK, 8CO, 9IC, 8ACK, 5BU, 8AOZ, 9IK, 5OX, 5CW, 5AA, 9GY.

5DU—heard by 9BJ, 8NH, 9JT, 9FW, 9ADT, 5CQ, 9RD, 9DK, 9VS, 9IC, 6DM, 8ACK, 5BU, 5BV, 5EK, 9IK, 5OX, 5CW, 5AA, 9GY.

9FA—No one reported that they heard these sigs.

6SL—No one reported that these sigs. were heard.

6SH—heard by 9LP, 9ADT, 6AS, 6PN, 6WF, 6SR, 6SL, 7YS.

IATY—9LP claims to have heard this station but did not read his mistake.

9KT—heard by 9LP, 9IC, 9VS.

9IC—heard by 9BJ, 9RD, 9ADT, 9DK, 8CO, 5BV, 9IK, 9LW, 8ALE, 8NH, 8ACK, 9HQ.

9RK—No one reported hearing this station.

9DK—heard by 9ADT, 5BV.

8AOZ—No one reported the sigs. from this station.

8CO—heard by 9BJ, 9DK, 3ST, 3GX, 3RD, 8ALE.

3RD—No one reported this station.

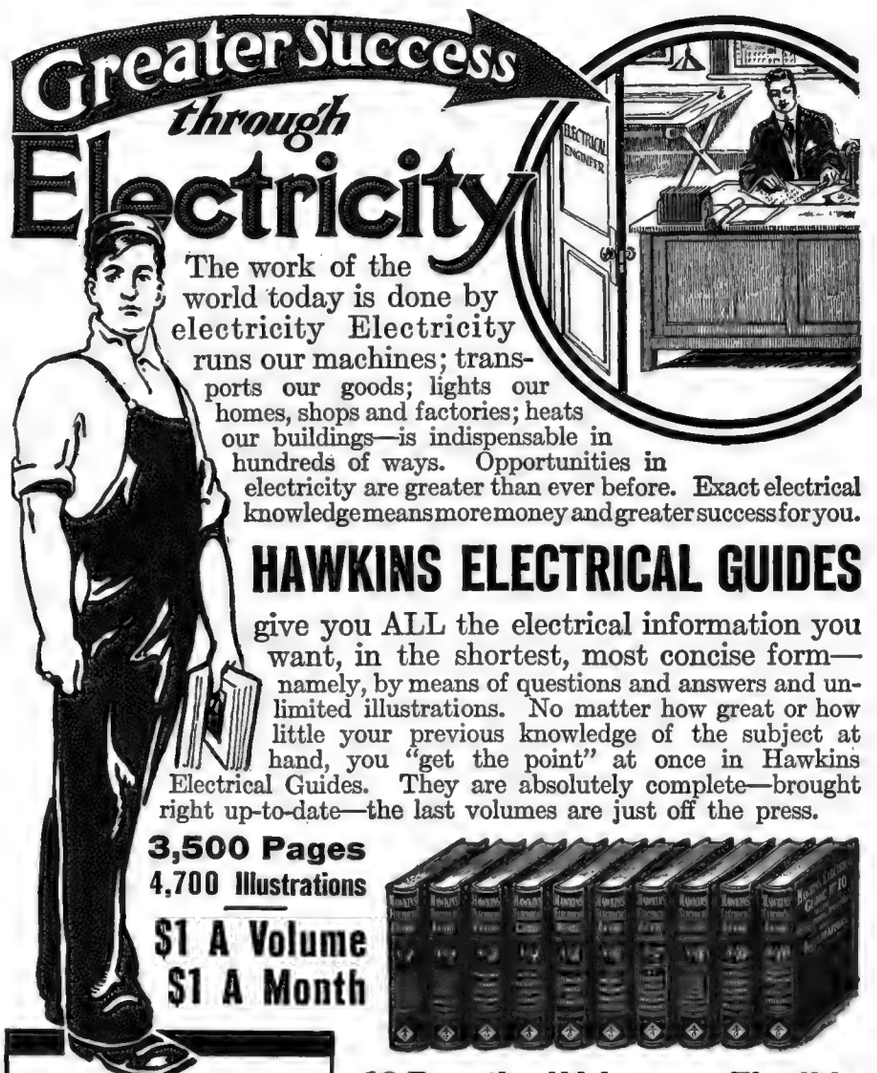
6TQ—heard by 6SH, 6WF, 6SR.

5OX—No one reported the sigs. from this station.

4DI—8ALE and the station on Bailey Island, Maine, as well as lots of local stations and 3GX, 3ST in Richmond, Va., heard this station.

The writer extends his thanks to the three bureaus of information—F. B. Chambers Co., of Philadelphia, Pa.; Illinois Watch Co., of Springfield, Ill., Mr. G. S. Johnson. 6SH—our Western friend, MacQuarrie.

(*Continued on page 687*)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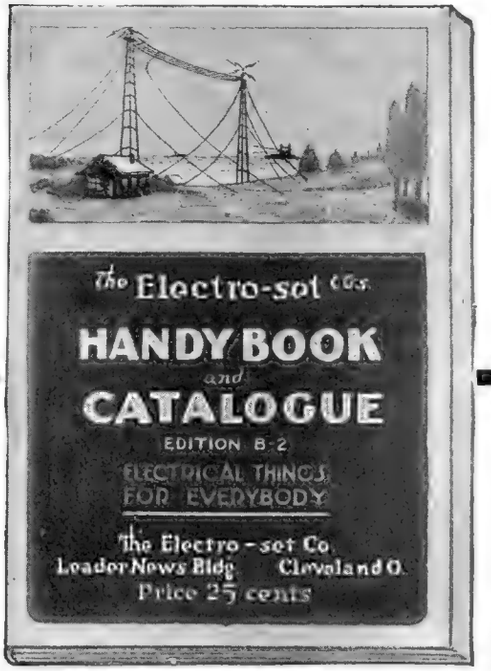

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(*Continued from page 685*)

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Cordially yours,
9XE, Davenport, Iowa.

HOW ELECTRICITY HELPS TO MINE AND REFINE GOLD.

(*Continued from page 632*)

not raise the temperature of the water, but they aid in holding it just where it is. It is the same water falling that furnishes the electricity.

At North Fork, thirty miles up the Klondike Valley, one finds the electric plant. The ditch is 30 feet wide, about six feet in depth and *six miles in length!* The water flows down thru the ditch and drops down thru great pipes, with a fall of 220 feet on the turbines, and it keeps the latter moving all the year round.

The principal clearing house in the United States for gold shipments from abroad, such as those sent us by foreign Governments now engaged in the great European war, and amounting to millions upon millions of dollars, is the Government Assay Office, in New York City.

To visit the Assay Office is to bring back the dreams of King Midas and his much hoarded coin. The average person who has never visited this establishment would hardly believe that gold and silver would ever be handled in such an apparently careless manner. There is now more gold stackt around the corridors and strong rooms of the Assay Office in boxes, kegs, bricks and bags than ever before in the history of the country. British sovereigns, packt in boxes are piled up halfway to the ceiling.

Upon entering the doorway to the Assay Office, the visitor, especially if he be a stranger, is met by several armed guards: but once his business is made known, he is treated courteously and finds but little trouble in passing on to the proper departments. But make sure that the attendants at the entrance, know exactly from whom you come and just what is your business!

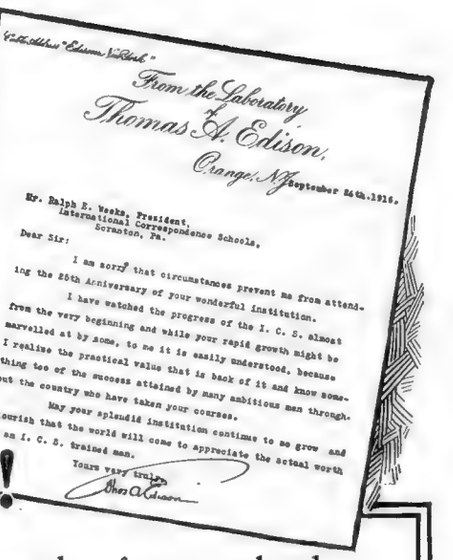
The visitor, as he passes along the corridor, is likely to bump into a stack of 20-franc pieces on one side and a stack of gold bars on the other; and turning to reach the elevator he skirts the outward row of United States gold bars packt five $10,000 bars to the keg, which stretch along the wall twice the height of a man.

The United States Government, of course, is now extremely wealthy, and its purchasing agent for all its vast deposits of gold stored in various sub-treasuries and at Washington is the Assay Office.

The gigantic gold consignments from foreign countries which have been shipt to America in the past two years with which to pay the titanic bills for munitions and other war-time necessities are casht in thru the Assay Office.

More than one quarter of a billion dollars has been released during the past fiscal year and more than $130,000,000 has been received since July last.

For the year ending October 1st the deposits at the Assay Office in New York City amounted to $4.30 per capita for a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I am sorry that circumstances prevent me from attending the 25th Anniversary of your wonderful institution.
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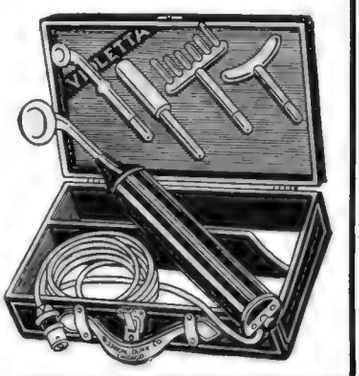

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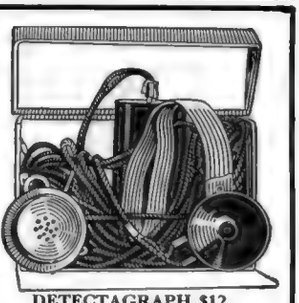

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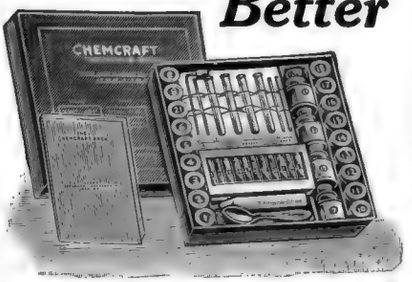

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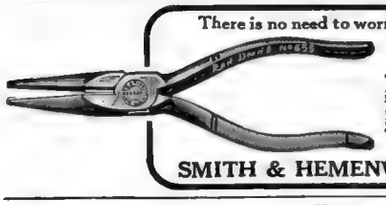

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population of 100,000,000 people. It is hard to conceive in the mind as to just what these figures mean.

The Assay Office has been fairly swampt with silver and gold, but principally the latter. The predominant specie in the foreign shipments received were British sovereigns and French 20-franc pieces. The largest single deposit made during the past year amounted to $37,500,000, which is "some" shipment to be cared for and guarded all in the space of one day!

The method by which deposits are converted into United States money is as follows: The depositor has mixed bullion of a fineness of 800 thousandths or over, or fine gold. It is brought to the Assay Office, received and weighed and a preliminary assay made by which its approximate value is determined. A receipt is given for the weight found and upon completion of the preliminary assay a check on the Treasurer of the United States may be drawn by the superintendent at his discretion for 90% of its value. The Treasurer places to the credit of the Superintendent, from time to time, such amounts as are necessary to be drawn against. The deposit is then melted, final assay made, and its actual value determined, and a check for the balance, less the charges, is given upon surrender of the original receipt. Final payment is usually made in about five days after the receipt of the deposit. The check is deposited in the usual way or may be immediately casht at the United States Sub-Treasury, in United States gold certificates or gold coin. As the gold certificates go out, their actual value in gold bars is thus deposited in the Government's vaults. The deposit is immediately taken to the melting room of this same department and melted and moulded into bars. This melting process thoroly mixes the metal.

Each deposit is a separate melt. Samples are taken from the molten metal and from these samples the final assays are made and the character of the deposit determined. The weight after melting is the weight that controls in determining value, as low grade deposits lose heavily of their base metals during the melting process, while the loss on fine gold or silver is infinitesimal.

At this after-melting weight the deposit is turned over by the head of this department to the superintendent of the melting and refining department. He, in turn, is charged with the separation and refining of the gold and silver and its being put into the final form of fine gold or silver bars. All metal is refined to a fineness of 999.5 or finer, gold often being refined to 999.9. The superintendant of the melting and refining department in turn verifies on his own scales the weight, and in case of mixed bullion, again in his furnaces melts the deposits and moulds it into *anodes* or short slabs about 18" long and ½" thick, in which the dominant metal is silver. These anodes, in turn, are taken to the silver refining room, and by a special electrolytic process the silver is extracted. This fine (refined) silver is then in the form of coarse silver sand. It, in turn, is again melted and cast into fine bars of various standard sizes.

The residue remaining after the extraction of the silver is in the form of a black, porous, brittle substance, about 900 fine gold. This is again melted, in this same department, and cast into *anodes* or slabs, a little smaller than the previous silver anodes. These are taken to the gold room and by the same marvelous electrolytic process the pure gold is extracted or refined to a fineness of 999.5 or over. This re-

sults in a warty, irregular slab of pure gold and this, in turn, is again melted and cast into the final form of fine gold bars. In the meantime the assayer has, in his department, determined the fineness of the metal and from this the value of each bar is determined. The finished bars are then stampt with their weight, fineness, value, melt or deposit number and the identifying stamp of the Assay Office and are now ready to be turned over to the cashier, who, acting for the superintendent, receives them, to be stored in the vaults or to be exchanged for gold coin. At the close of business each day a statement showing the transactions for the day and final balances on hand is forwarded to the Treasurer of the United States by the superintendent.

RADIO DETECTOR DEVELOPMENT.

(*Continued from page 680*)

Barretters were usually arranged in parallel and shunted by a telephone receiver joined in series with a source of current, such as a single dry cell. Hence, any variation of resistance of the barretter loops due to the heat produced by the Hertzian wave currents, would be manifested in the telephone receivers owing to the change in the amount of battery current past thru the circuit.

The *Carborundum Detector*, discovered by General H. H. C. Dunwoody, U.S.A., (Fig. 9) involves a marvelous characteristic possest by a number of minerals, viz., that of rectifying an oscillating (alternating) current of practically any frequency. The carborundum detector in its usual form comprises two rather stiff springs, adjustable as to pressure, between which the carborundum (carbid of silicon) crystal (preferably an extremely jagged, greenish specimen) is placed. A pair of high resistance telephones are shunted across the detector and the incoming Hertzian wave oscillations, representing the dots and dashes of the telegraphic code, are manifested as short and long signals in the 'phones owing to the fact that the carborundum crystal will pass currents *several hundred times* better in one direction than it will in the reverse direction. This action is enhanced by mounting the crystal in a cup or clamp of large section, making the second electrode of very small contact area. A steel needle has been used effectually as the small electrode and in one commercial instrument the smaller electrode has been made of several steel needles in contact with the carborundum.

Thus, the high frequency oscillations, or, rather, *groups* of oscillations, are rectified and the summation of each train of waves reacts on the 'phones. Battery current usually intensifies the action of the carborundum detector, but its polarity must be watched, as also the potential applied. A potentiometer is best employed to regulate the current applied to the detector.

One of the best known radio detectors, and one that is now in extensive use, is the *Silicon Detector*. This is illustrated at Fig. 10 and employs a piece of the mineral Silicon embedded firmly in a brass cap. A solder or low heat alloy such as Hugonium metal is best used in mounting such minerals, so as not to injure their radio detecting properties or sensitivity.

The Silicon detector is generally used without any battery and acts as a rectifier, similarly to the carborundum detector. A pair of 2,000 ohm 'phones or higher resistance ones, are shunted across the detector usually and owing to the rectifying action already described, the incoming Hertzian wave currents are manifested as short and long sounds in the 'phones.

At Fig. 11 we have the *Perikon Detector* developed by G. W. Pickard. This detec-

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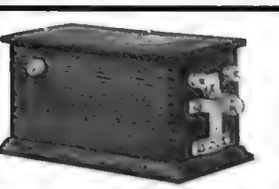

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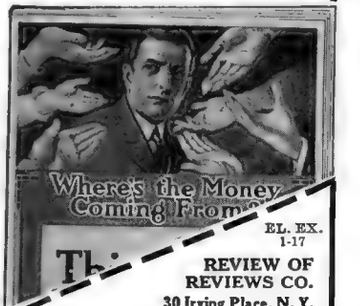

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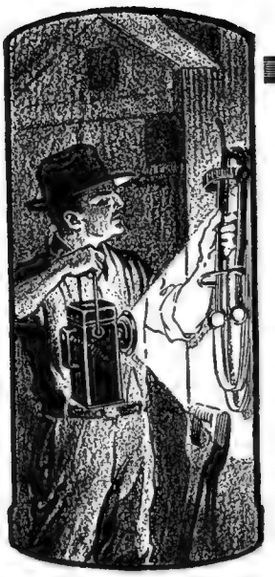

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tor consists of two crystals—copper pyrites (Cu Fe S_2) and zincite (zinc oxide ZnO), held in firm contact against each other in the manner shown. The copper pyrite crystal is mounted in a cup mounted on a spring-actuated rod provided with a suitable knob, by which it can be swung in any direction. Zincite crystals are mounted in a large cup containing several pockets, the mounting of both of the minerals being effected with a low fusing solder, Wood's metal or Hugonium alloy. The action of the Perikon detector is supposed to be based on the rectifying principle previously described; that is, it will pass current in one direction but not in the other, and thus the incoming radio frequency oscillating (alternating) currents in the aerial are rectified and caused to give a sound in the high resistance 'phones connected to the detector. This detector is invariably used with a battery of about two cells and the potential applied regulated by a potentiometer. When using a battery the polarity of the current must be such that the positive wire is connected to the copper pyrite crystal.

One of the most sensitive detectors, and one of the most popular with the radio amateur, because of its extreme simplicity, is the *Galena Detector*, Fig. 12. In this instrument a piece of Galena (lead sulfide) is mounted in a brass cup by means of solder or other low fusing alloy and a light phosphor bronze wire called a *catwhisker* rests gently on the surface of the mineral. It is sometimes difficult to find sensitive specimens of Galena, but it is a matter of record and a proven fact, that when a really first-class specimen is obtained, it is practically second to no other detector, not even excepting the Audion. Messages have been received with a Galena detector and simple equipment comprising a tuning coil, tin-foil and paper condenser and a single, high resistance telephone receiver over a distance of 2,500 miles, when the transmitting station was rated at only 5 K.W.

The Galena detector is practically never used with a battery and acts on the rectifying principle possest by the minerals already discust.

The *Crystaloi Detector* (Fig. 13) is a very novel instrument and comparatively young as detectors go. The detector does not require a battery and has a sensitivity on par with the average run of mineral detectors. It comprises a hollow drum, or rather disk, as shown in the illustration. This is supported between two vertical spring clips so that the drum may be rotated on its axis until the maximum sensitivity is attained. Practically all mineral detectors and also the Crystaloi are adjusted to maximum sensitivity by a "buzzer test." An ordinary buzzer and battery, together with a key or push button, completes this important piece of apparatus, and a single wire from the contact screw in front of the buzzer armature is connected to the detector circuit or aerial circuit.

The Crystaloi detector has two metal discs or plugs inserted in either side of the hard rubber revoluble drum, one of which contains a small piece of sensitive mineral. The space between the two metal disks is partially filled with a special mixture of certain light metallic filings. When adjusting this detector the revoluble drum is moved a little at a time until the metal filings take up their proper position, making contact between the plain metal disk on one side and the sensitive mineral on the other. This action is quickly brought to a maximum by the application of the buzzer test current thru an inductance of several turns of wire. A pair of high resistance 'phones should be used with this detector. Contrary to other mineral detectors, where only one "catwhisker" contact wire is used, the Crystaloi uses the many contacting points of the filings.

The *Fleming Valve Detector* of Hertzian oscillations (Fig. 14) is based upon the principle that if we have a hot or incandescent electrode, and also a cold electrode, both mounted within an evacuated glass chamber, a rectifying action will be created, i.e., that negative electrical charges, such as those from a battery of 30 to 40 volts or even less, can pass from the hot filament to the cold electrode but not vice versa. In the Fleming Valve, the cold electrode takes the form of a metal cylinder surrounding the incandescent filament. This arrangement acts as an electrical valve for oscillating or alternating currents of any frequency. The space between the cold cylinder and the hot filament is therefore said to possess unilateral conductivity. The Fleming Valve possesses a fairly high sensitivity; it is used with a pair of high resistance head 'phones, a suitable battery and auxiliary regulating apparatus. The wireless receiving phenomenon occurring will be evident from the foregoing and is in a sense of a rectifying nature similar to that possest by the mineral detectors.

The *Audion Detector* (Fig. 15) employs three distinct electrodes as shown, viz., a filament—a grid—and a wing or plate. The grid, composed of a wire member as indicated, is placed between the filament and wing. The oscillations when they pass thru the Audion detector are subjected to a similar action to that occurring in the Fleming Valve; that is, they are rectified, but in so doing they are claimed to also effect a relay action with respect to a high voltage battery of 40 to 50 volts potential, connected to a pair of high resistance telephone receivers in the wing circuit. Thus, with the Audion it is seen that, owing to the suggested relay action inherent in its operation, it is quite possible and practical to have such an action occurring of considerable magnitude; that is, the ratio between the amount of energy passing into the Audion from the antenna circuit, and the amount of energy controlled by the relay or trigger action in the high voltage 'phone circuit may be quite large.

Several years ago, when the first radio transmission was being tried out between Honolulu and San Francisco by the Federal Telegraph Company, it was found that due to the extreme sensitivity and amplifying action of the Audion, the signals could be copied several hours longer each morning than with any other detector; the signals *fading* as dawn approached, owing to the supposed ionization of the upper atmospheric strata by the sun's rays.

There was, for a number of years, a great controversy on between the de Forest and the Marconi experts as to the validity of the Audion patents. This matter was discust in the November, 1916, and also in the December, 1916, issues of this journal and those interested had best read both of these excellent articles as well as a very exhaustive article explaining the action of the Audion which appeared in the August, 1916, issue of THE ELECTRICAL EXPERIMENTER.

The *Electrician* in a recent issue suggests that we should offer a solution of a problem of etiquette in answering the telephone. Should one say "Robinson speaking," or "Mr. Robinson speaking"? Plain Robinson seems preferable, unless it is obvious that we are in communication with some office boy or domestic servant. The *Electrician* tentatively suggests the employment of initials, but it hardly seems feasible to use a collocation of stray vowels and consonants. "H. S. deV. J. Baffington," for instance, might be trying on the telephone, while "R. U. Smith?" has its obvious inconveniences. What?

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

ELECTRIC CIGAR LIGHTER.

(118.) W. M. Dennis, Des Moines, Iowa, claims to have invented a small electric cigar lighter so arranged that it can be used in place of a bulb in a pocket flashlight, while a metal cap will protect the clothing if the latter should become short-circuited. Our advice is desired on this invention.

We do not see how this device will work in connection with a pocket flashlight as its current is certainly too weak to bring an electric heater to full glow for use in cigar lighting. Such lighters as a rule consume a lot of current, and for this reason we do not think the device practical.

COMBINATION SWITCH.

(119.) Earl Anderson, Spokane, Wash., has submitted to us drawings and a full description of a device which he calls a combination switch and he wishes to have our advice as to the usefulness and patentability of this article.

This is a very clever article and we think it should fill a decided want. We also think that a patent might be obtained on the article, if some of the lesser details are worked out carefully.

PHONOGRAPH SYNCHRONIZING DEVICE.

(120.) O. S. Wright, Ithaca, N.Y., has written us as follows:

> "In your columns of the July issue you state that there is no serviceable device for controlling sound in synchronism with motion pictures. These conditions rather surprise me and I herewith enclose a sketch of a proposed mechanism for controlling a phonograph in connection with the pictures. I have also a proposition for producing the objects on the screen in their original color without resorting to any pigments or other colored moving parts. Both these devices appear very simple and I would consider it a favor to have your criticism on them, both as to their possibility, practicability, novelty and if they are sufficiently meritorious to commend their completion and commercial production."

We have carefully investigated the idea accompanied by drawings and description and have come to the conclusion that this apparatus will probably work as indicated, although we think that the apparatus is somewhat costly and we do not know whether it would work well at all times. We would advise the inventor to have a model built and carefully test it out. If the apparatus works as outlined, we think a valuable property can be developed from it. Our correspondent has also sent in a scheme for producing moving pictures with natural colors. We do not think upon looking this over that it will do what our correspondent claims for it and furthermore we think it would be too costly in its operation. We have come to this conclusion after looking the drawing over carefully, but before entirely condemning it, we would like to see a model in actual working condition.

MARVELS OF MODERN PHYSICS.

(*Continued from page 647*)

switch on point 2 allows the condenser to momentarily discharge, and then it is quickly put on point 3, where the polarizing E. M. F., which is soaking out of the crystal in a direction *opposite* to the applied E. M. F., is balanced against a small difference of potential in the resistance wire a, b. This is repeated several times with different values for "a" and "b," until the potential across a—b exactly balances the polarizing E. M. F. of the crystal. This point can readily be found by means of the quadrant electrometer at QE. This is in circuit with the crystal thru earth connections on both sides, and when no deflection of the needle is noticed, the two currents are in equilibrium. The potential between the points a—b can be readily measured by any means at hand, and this of course is equivalent to the polarizing E. M. F. of the crystal. It is still an unanswered question as to whether the conduction in such a crystal is electrolytic or metallic; that is—whether the molecule really breaks up chemically or whether the electrons move from one molecule to the next, without disturbing the structure of the molecule. It is probably a common idea that an insulator is an absolute non-conductor. The above experiment emphasizes the fact that this is not strictly true, but of course it must be remembered that the current thru the dielectric due to the polarizing E. M. F. is very, very small, and can only be made large enough to detect by an ordinary galvanometer, by heating the crystal to a high temperature. The whole problem of dielectric conduction is important because of the light it sheds not only on condenser phenomena, but also on fundamental questions of physics underlying it. This is a typical modern scientific problem.

It is highly probable that in the not too distant future the old Physics will be discarded, and a new one take its place, based on the rapid growth and meaning of elec-

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trical science. Now-a-days the ordinary text-book is divided into sections, treating separately of mechanics, heat, sound, light, magnetism, electricity, and radiation. These divisions are arbitrary and more and more we are coming to see the relations and connecting links between all natural phenomena. Radiation, including heat and light, is electro-magnetic. Magnetism is the product of electricity in motion. Sound is a result of vibration of matter. Mechanics treats of interaction between force and matter, and matter and force both are probably *electrical* in fundamental nature, so the future may see all these topics grouped under a general electrical heading.

At present, scientific progress steadily continues. Mr. C. T. R. Wilson has photographed the paths of both *alpha* and *beta rays*. Prof. Michelson has rendered a distinct service by measuring the length of the standard meter in terms of wave lengths of the red line of cadmium light, to eight significant figures! This gives us an invariable standard. Then by many others research is being carried on in various fields, but the field of radiation seems the most fruitful.

Theoretical progress is the forerunner of practical advance, and last year bigger and better machines were manufactured than ever before, and finer apparatus. The 35,000 kilowatt steam turbo-generator made its first regular commercial appearance. Engines of 100,000 H.P. were installed on the latest dreadnaught. Argon gas was introduced into incandescent lamps, and the use of electrical apparatus has spread from railways to the textile industries, and from mining camps to the farm. Such a wide distribution must indeed offer many opportunities to the man who is trained. Training is the all important factor in success, whether it be derived from the work bench and library at home or whether obtained in the university.

A recent writer on the subject said that the intellectual rise in electricity had reached a final climax when electricity, magnetism, and lightning were identified as one. This was a climax surely, for the old superstitions soon disappeared. No longer was lightning ascribed to the work of evil spirits, and no longer was the magnet used as a charm against disease as by the Rosicrucians. Are we not, however, at the dawn of a new intellectualism, where the meaning of life and nature will become more apparent to us? Already in the last quarter of a century we have discarded many of our old worn-out theories and are assuming new ones that give new meaning to our views of matter, ether, electricity and the universe.

Fate seems to be shaping events now with a view toward making the United States supreme in commerce and industries. So also must she take the lead in science in order to maintain her position. This means added opportunities. In Fig. 3, the path is graphically outlined which leads to success in the greatest branch of engineering, the *electrical*. Erecting, operating and research are the three important fields, and they may be reached by various steps, a few of the more important of which are suggested. No one can evade the apprenticeship whether at home, in school, or in the operating plant. Success in any line awaits the man who is not afraid to work!

[*This is the twelfth and final paper of a series prepared exclusively for "The Electrical Experimenter" by Mr. Rusk.—Ed.*]

An American firm has just been awarded the largest European contract for telephone apparatus and material ever let outside of Europe. It involves a 35,000-subscriber automatic exchange for Christiania, Norway, costing about $1,250,000.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 666*)

composition of water by either Sodium or Potassium are as follows:—

In the case of Sodium,

$$2\,Na + 2\,H_2O = 2\,NaOH + H_2$$

Sodium [Metallic] Water Sodium Hydroxid Hydrogen

In the case of Potassium,

$$2K + 2\,H_2O = 2\,KOH + H_2$$

Potassium [Metallic] Water Potassium Hydroxid Hydrogen

EXPERIMENT NO. 30—

If the apparatus as described in the October issue of THE ELECTRICAL EXPERIMENTER has been made, the preparation of Hydrogen by the Electrolysis of Water is made in the following manner:

Set the delivery tubes in a two-holed rubber stopper as shown by Fig. 25. Next fill the U-tube as shown by Fig. 24 with water, to which a small quantity of Sulfuric acid has been added, in order to conduct the electric current better. Insert the stopper containing the delivery tubes and electrodes and fasten to the ring stand, as shown by Fig. 22. The balance of the apparatus is set up as shown in Fig. 21. Bottles may be used to collect the gas in place of the test tubes as shown.

Attach the wires to the supply of current and watch the changes occurring within the U-tube.

The Hydrogen is collected from the cathode [or negative electrode], while Oxygen is liberated from the anode [or positive electrode].

Apply the splint tests to the gas collected from the cathode electrode in the same manner as in Exp. 23.

Apply the splint tests to the gas collected from the anode electrode in the same manner as in Exp. 17, or any of the Experimental tests for Oxygen.

Certain metals which do not decompose water at ordinary temperatures, or which decompose it slowly, decompose it easily at high temperatures. This is true of iron. If steam be passed through a tube containing pieces of iron filings, or fine bright iron wire heated to redness, the water is decomposed, the Oxygen is retained by the iron in chemical combination, while Hydrogen is liberated

$$3\,Fe + 4\,H_2O = Fe_3O_4 + 4\,H_2$$

Iron Water Ferrous Oxid Hydrogen

When Carbon Monoxid is introduced into Calcium Hydroxid [$Ca[OH]_2$] Calcium Carbonate [$CaCO_3$] and Hydrogen are liberated.

$$Ca[OH]_2 + CO = CaCO_3 + H_2$$

Calcium Hydroxid Carbon Monoxid Calcium Carbonat Hydrogen

ACTION OF DETECTORS IN WIRELESS TELEGRAPHY.

(*Continued from page 654*)

line body and some other body permits the passage of electrons more easily in one direction than in the other, this would account for the rectifying effect, and would also account for the thermo-electric effect, provided the velocity of the electrons is suitably different at different temperatures.

7. The thermo-electric explanation of the rectifying effect, if we had found it to be supported by the experiments, would have correlated the phenomenon of rectification at a solid contact with the body of information that we already have in regard to thermo-electricity, but we should still have had by no means a complete knowledge of the action.

8. From experiments with thermo-electricity we are familiar with the fact that the energy of an oscillatory electric current passing thru a high-resistance contact is partially converted into heat energy, and that the heat energy so obtained, if produced at a thermal junction, is again partially converted into electric energy mani-

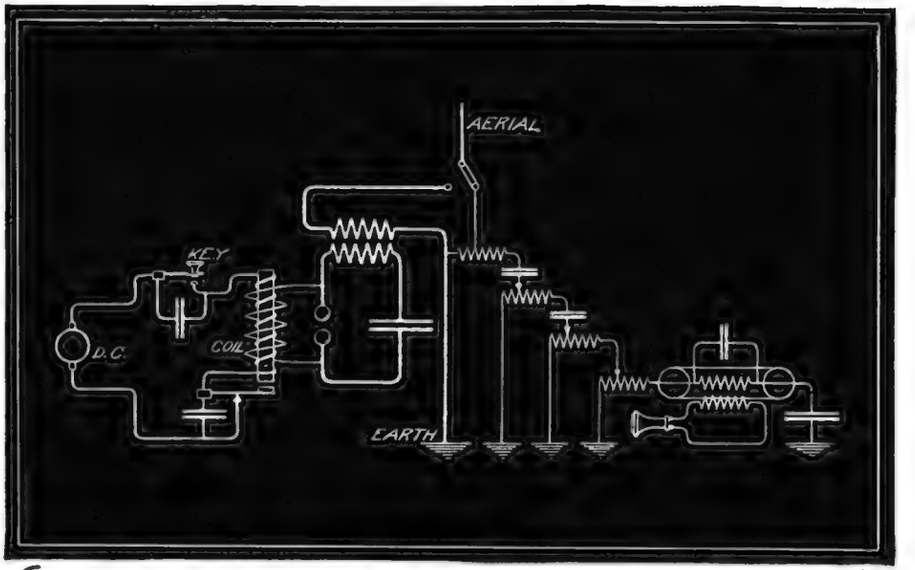
festing itself as a direct current. It is perhaps, after all, more simple to suppose the alternating current to be converted into direct current without the intermediation of heat; and this seems to be the case with the crystal contact rectifiers. This result opens up a new field for investigation, which may contribute to a better understanding, not only of thermal electricity, but of the much larger question of the mechanism of electrical conductivity in solid bodies.

Under coherers Pierce includes only those detectors which employ a loose contact and require to be shaken, tapt or otherwise moved to restore the contact to its sensitive condition after the receipt of a signal. A great many modifications of the Branly coherer have been made, including the use of a single contact or a few contacts in series or parallel, between metallic balls or points to take the place of the filings.

These various forms of coherer have their importance in the fact that, on the receipt of electric waves, a sufficiently large current is started in the local circuit to operate a relay, ring a bell, or give other form of alarm that can be heard at a distance from the operator's desk. Also the current permitted to flow in the local circuit of the coherers during the receipt of electric waves is sufficiently large to start machinery and control a mechanism (for example, a torpedo or dirigible craft) at a distance. This kind of result is not easily attained with the other forms of detectors, which do not permit of the use of sufficiently large currents in the local circuit to sound an alarm or start electrical machinery. Thus the coherer, though lacking in sensitiveness to feeble waves and not now generally employed in the receipt of messages, has still a distinct field of usefulness.

Besides the filings coherer we shall describe here another interesting form of coherer—that devised in 1902 by Lodge, Muirhead and Robinson. This instrument consists of a small steel disc, rotated vertically by a clockwork, so that the disc is just separated from a column of mercury by a thin film of oil on the surface of the mercury. One electrical contact is made to the wheel thru a brush, and the other connection is made to the mercury well thru a binding post The impulse of the electric oscillations breaks down the oil film and establishes momentary cohesion between the steel disc and the mercury. A current from a local battery passes thru the disc and mercury contact, and operates a siphon recorder, which is used in series with the battery and the coherer. After the impulse ceases, the motion of the disc brings continuously a fresh oil film into the contact and causes de-coherence. The siphon recorder gives a written record of the dots and dashes of the message. A felt brush serves to keep the rotating disc free from dust before and after contact with the mercury.

A generally accepted theory as to the reason for the coherence of the filings, or other form of imperfect contact used in the coherers, has not been establisht. I shall state briefly some of the views presented in explanation of the phenomenon. Before the arrival of the waves, the high resistance of the contact is generally supposed to be due to the presence of some kind of poorly conductive film at the contact. In the case of the Lodge-Muirhead coherer, the insulating film is evidently present in the form of a film of oil. In many of the coherers a poorly conductive film is present in the form of an oxide of the metal. This is evident from the fact that in some cases the metallic particles (*e.g.*, iron or steel) are artificially prepared by oxidizing them in order to make of them a good coherer. The poorly conductive film may also be present in some cases in the



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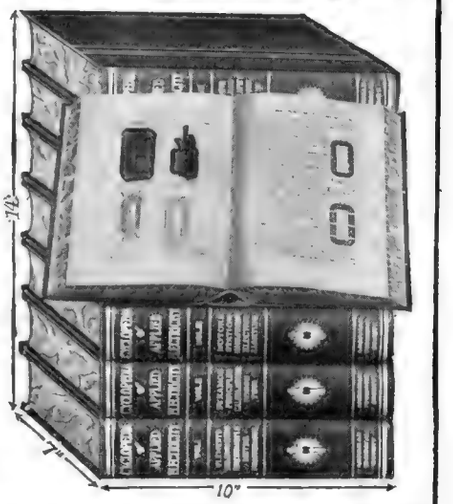

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form of a sulfid of the metal. On account of the readiness with which many metals (called the baser metals) enter into combination with the oxygen or sulphur dioxid of the air, a thin film or sulfid is always present on the surface of most of the baser metals, unless special care is taken to remove it.

Apart, however, from the existence of such films of foreign matter at the contact, it seems not impossible that the high resistance before the arrival of the waves may be a property of the surfaces of even pure metals when these surfaces touch only very lightly. If we assume the presence of the poorly conductive film at the contacts of the coherer, we may suppose that, on the arrival of the electric waves, the poorly conductive film is removed by the heat developed by the oscillatory currents. This starts the local current which, developing further heat, still further improves the contact and permits the passage of further current. Instead of heat being the chief agency in removing the oxid or other poorly conductive film, or in bringing together the loose contacts, it may be that this is done by the electric attraction between the filings, which before the current starts will be charged with opposite signs of electricity, and which under the added electromotive force produced by the electric oscillations may attract each other strongly enough to pull the contacts together.

According to the theory advanced by the author, the air film is the essential thing and the oxid film is more or less secondary. The thicker the oxid film is, up to a certain limit, the thicker will be the air film and the higher the voltage necessary to cut down the resistance markedly. That the conducting particles should cohere is not surprising. The only reason why two pieces of the same metal or two pieces of porcelain do not become one piece when pressed together is because of the absorbed air on the surfaces. As Breuer says: "All solids condense on their surfaces certain amounts of gases from the air and hold them with great force. The new surfaces, which are formed when a porcelain plate is broken, are covered instantaneously with particles from the surrounding atmosphere, and these are held in place powerfully as a thin, adherent elastic cushion. The portion of this layer which is next to the porcelain is believed nowadays to be as solid and dense as the porcelain itself, while the outer surface has the density of the air. A simple mechanical pressure, no matter how strong, is therefore not sufficient to bring the porcelain surfaces into intimate contact."

When the air film is removed more or less completely, the solid particles stick to one another more or less tightly and have to be separated by tapping, shaking, or other means. Depending on the conditions of the experiment we may have the oxid films coalescing or the metals themselves. If sufficient energy is expended at the contacts we may have fusion; but this is not a necessary part of the theory. From this point of view the essential difference between the coherer and the crystal detector is that coalescence does not take place readily in the latter case and does in the former. Experiments on welding by pressure give independent confirmation of this fact.

While Robinson gives quite a different theory of the coherer, it only calls for a slight change in the wording of his argument to make it applicable to the theory I have outlined. In connection with the action of the Lodge-Muirhead coherer it is interesting to note that Lenard found, nearly thirty years ago, that mercury "wets" platinum only when a current is flowing.

At other times there is evidently an *air film* present.

Brown superposed an alternating current on a cell, $Zn|H_2SO_4|C$, and found that the polarization was decreased thereby. "By making the surface of the anode in contact with the electrolyte small in area, the action of the alternating current will be concentrated and the ions will be correspondingly increased in chemical activity. In one case the anode was constructed of a fine platinum wire dipping about one-tenth of an inch into the dilute sulphuric acid and an external battery of two volts applied. When the alternating current was superimposed the platinum started to oxidize, and in a short time the whole of the wire in contact with the liquid was turned into a black powder. The same thing happened with gold, the wire turned into a yellow insoluble powder. With the filament of a carbon lamp as anode the carbon was completely dissolved or turned into gas; and, in fact, no conducting material could be found that would resist the combined action of the two currents when applied in this concentrated manner.

CONCLUSIONS.

The general results of the author's researches are:

1. The coherer, the electrolytic detector and the crystal detector act as they do because an electrical stress decreases the thickness of the absorbed gas film and therefore decreases the resistance.

2. The unilateral conductance of the crystal detectors is essential when there is no battery in the local circuit; but it is of no theoretical importance when a battery is used.

3. The essential difference between the coherer and the crystal detector is that coalescence takes place readily in the first case and not in the second.

4. It is not necessary that the oxide film of some coherers should be removed by the current, though this may happen.

5. In the crystal detectors the marked changes in the behavior of adjacent portions of the same crystal face are probably due to localized impurities.

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THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page 657*)

or varied by effecting a change in the reluctance of the magnetic circuit of the primary coil. It is possible with this transformer to shunt more or less of the primary flux thru an auxiliary laminated iron branch core X. This branch core may have its magnetic reluctance varied by means of a tapered iron plug as shown, which works on a gear attachment so that it may be inserted more or less into the wedge-shaped gap in the main core. The further this plug is inserted into the gap, the more pronounced the primary self-inductance and the smaller the current consumed, and of course the current in the secondary is also reduced correspondingly. As this iron plug is removed from the gap the primary and the secondary energy increases.

Several years ago there was a very unique and efficient radio transformer brought out and which is shown by the diagram at Fig. 4-B. This closed core transformer was constructed with two projecting laminated iron core legs, X—X, which could be shunted by a movable iron core leg X_1, carrying the auxiliary primary coil, P_1. It will be readily seen that this design provided excellent opportunities for a fine regulation of not only the input and output of the transformer, but also of the general resonance or tuning characteristics.

An adjustable choke coil of suitable proportions connected in the primary circuit of a radio transformer will aid considerably in tuning a complete transformer radio set, as has been found by the Marconi Company; and practically all of their radio sets are equipt with suitable choke coils for this purpose.

One of the leading manufacturers of experimental radio transformers has favored a closed core design with an auxiliary laminated leg as shown at M, in Fig. 4-B. This auxiliary leg is shorter than the coil legs so as to leave a small air gap N. Of course, with this scheme, the transformer, once it is built, is set, so far as its regulation and leakage is concerned, and does not possess the tuning and regulating characteristics that such a transformer as that shown in Fig. 4-A would manifest.

A discussion of the importance of resonance tuning characteristics in radio transformer circuits is given in the work *Wireless Telegraphy* by A. B. Rolfe-Martin. If we insert a variable inductance in the primary circuit of a transformer, we have a ready means of tuning the whole arrangement to any desired period within limits. Furthermore, a suitable inductance in the primary circuit will control the input in the transformer and hence the output as aforementioned, and will prevent arcing across the spark gap in the secondary circuit almost as effectively, if not quite as well, as when choke coils are connected between the secondary terminals and the leads of the oscillatory radio-frequency circuit.

It is well to mention here that all of the best transformer type radio transmitting sets, however, are equipt with light air core choke coils connected to the secondary terminals, which serve to protect the transformer secondary winding from any reflex oscillations or static kick-backs from the condenser helix spark-gap circuit which, in many instances, has resulted in the rupturing of the insulation in the transformer, necessitating its entire rewinding. The primary choke coil, moreover, need not be insulated to withstand the high tension of 15,000 to 20,000 volts produced by the secondary.

There now remains the question of the period that the low or primary frequency circuits are to assume, and they should preferably have the same period as the alternating current supply. If, for instance, we assume that the secondary oscillation condenser has .04 mfd. (4×10^{-8} farad) capacity and a transformation ratio of 20,000: 100 or 200, then, if we desire to design a suitable primary inductance, such that it will give a natural period to the entire low frequency arrangement equal to the period of an alternating current supply having a frequency of 200 cycles, then the time period in seconds would be equal to 1/200th second.

As the time period then of such a system is equal to 1/200 second and substituting the known terms in the time period equation:

$$t = 2\pi T\sqrt{LC}$$

in which T is transformation ratio, we get:—

$$1/200 = 2\pi\, 200\sqrt{4 \times 10^{-8} \times L}$$

or

$$\sqrt{L} = \frac{1}{16\pi}$$

which gives us a value for L of approximately .0004 henry. This is well within the design limits of a convenient primary choke or impedance coil.

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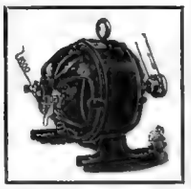

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NEW WIRELESS LAW PLANNED.

(Continued from page 671)

The Secretary of Commerce may upon request determine in advance of the erection of a radio station, on the basis of an application substantially conforming to the requirements of this Section, whether the apparatus to be installed in such station will be licensed upon completion of such station, and upon what condition such license will be granted.

Whoever shall knowingly make any untrue statement in the application for a license prescribed by this Section, shall be guilty of perjury and shall be punished by a fine not exceeding two thousand dollars, or by imprisonment for not more than five years or both.

Sec. 9. Station licenses shall be in such form as the Secretary of Commerce shall prescribe and shall contain a statement of the following conditions to which such licenses shall be subject:

1. The station shall at all times be subject to inspection by officials of the Department of Commerce; and the President of the United States, in his discretion, may cause the closing of such station and the removal of all radio apparatus, or may authorize the use of the station or apparatus by any Department of the Government upon just compensation to the owners, as provided in Section 14 (b) of this Act.

2. The ownership or management of the station or apparatus therein shall not change without the consent of the Secretary of Commerce, nor be transferred to an alien or aliens, nor to any foreign government or representative thereof, nor to any company, corporation, or association organized under the laws of a foreign country, or of which any officer, or more than one-third of the directors, are aliens, or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof, or by a company, corporation, or association organized under the laws of a foreign country. The ownership or control of more than one-third of the capital stock of any company, corporation, or association to which a station license has been issued shall not be transferred during the term of the license to an alien or aliens, or to a foreign government or representative thereof, or to any company, corporation, or association organized under the laws of a foreign country. No company, corporation or association to which a station license has been issued shall thereafter during the term of the license have any officer who is an alien.

3. The rates to be charged shall be as fixed by the Secretary of Commerce, and shall be specified in the license.

4. Apparatus other than that specified in the license shall not be used for radio communication.

5. Every licensed radio station open to general public correspondence shall be bound to exchange radiograms with any other such station without distinction of the radio systems adopted.

Such license shall also show specifically the ownership and location of the station in which the apparatus is to be used and such other particulars as the Secretary of Commerce may deem necessary for the identification of the apparatus and to enable its range to be estimated, shall show the purpose of the station, the rates authorized by the license, the wavelength or wave-lengths and the decrement or decrements authorized for use by the station, and th hours for which the station is licensed to work.

Sec. 10. Any station license shall be revocable by the Secretary of Commerce, in his discretion, for violation of or failure to observe any of the restrictions and conditions mentioned in the preceding section, or other provision of this Act or regulation of the Secretary of Commerce, and the books and records of the licensee shall be open at all times to inspection by officials of the Department of Commerce to enable them to determine whether such violation or failure to observe has occurred.

Sec. 11. Every radio station for which a station license is required by this Act shall be in charge of or under the supervision of a person to whom an operator's license shall have been issued hereunder. No person shall operate any such station except under and in accordance with an operator's license issued to him by the Secretary of Commerce. The Secretary of Commerce, in his discretion, may grant special temporary li-

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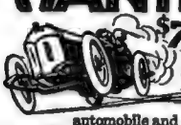

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censes to operators of radio apparatus when any emergency arises requiring the prompt employment of such an operator. Whoever shall employ any unlicensed person in the operation or supervision of any licensed radio station, or whoever without an operator's license shall operate or supervise such a station, shall be punished by a fine not exceeding one hundred dollars for the first offense, and by a fine not exceeding two hundred dollars or imprisonment for not more than two years, or both, for each offense thereafter.

Sec. 12. An operator's license shall be issued only in response to a written application therefor address to the Secretary of Commerce, which shall set forth the name, age, and address of the applicant, date and place of birth, the country of which he is a citizen, and if a naturalized citizen of the United States the date and place of naturalization. The application shall also state the previous experience of applicant in operating radio apparatus and such further facts or information as may be required by the Secretary of Commerce. Every application shall be signed by the applicant upon oath or affirmation. An operator's license shall be issued only to a person who, in the judgment of the Secretary of Commerce, is shown to be proficient in the use and operation of radio apparatus and in the transmission and receipt of radiograms. An operator's license shall not be granted to any alien or representative of a foreign government. Whoever shall knowingly make any untrue statement in an application for an operators license shall be guilty of perjury and shall be punished by a fine not exceeding two thousand dollars or by imprisonment for not more than five years, or both.

Sec. 13. An operator's license shall be in such form as the Secretary of Commerce shall prescribe, and may be suspended by the Secretary of Commerce for a period not exceeding one year, upon proof sufficient to satisfy him that the licensee has violated any provision of this Act or regulation of the Secretary of Commerce, or that he has failed to compel compliance therewith by an unlicensed person in his employ or under his supervision, or the license may be revoked by the Secretary of Commerce upon proof sufficient to satisfy him that the licensee was or is ineligible for a license.

Sec. 14. (a) Radio stations licensed under the provisions of this Act shall at all times be subject to inspection by officials of the Department of Commerce. During any war in which the United States shall be a neutral nation, and in time of threatened or actual war in which the United States may be a party, and in time of public peril or disaster, the President may, by proclamation or Executive Order, issue regulations for the conduct and censorship of all radio stations and radio apparatus of every form and nature within the jurisdiction of the United States. Any person who shall knowingly violate or fail to observe any of said regulations shall be punished by a fine not exceeding ten thousand dollars or by a term of imprisonment of not more than three years or both; and in case of any such violation or failure to observe any of said regulations, the radio station, or apparatus, or both, shall be liable to forfeiture to the United States.

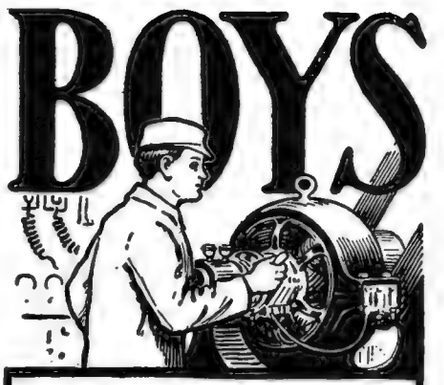
(b) The President, further, in his discretion, may cause the temporary closing of any radio station within the jurisdiction of the United States and the temporary removal therefrom of any radio apparatus for a period or periods of not more than five months each, or may authorize the temporary use of the station of the apparatus thereof by any department of the Government for a like period or periods upon just compensation to the owners.

Sec. 15. (a) Whoever shall maliciously or wilfully interfere with or cause any interference with radio communication carried on or sought to be carried on by any radio station or apparatus shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, for each offense thereafter.

(b) Whoever shall wilfully divulge or publish the contents, substance, purport, effect or meaning of any radiogram, or any part thereof, to any person other than the sender or addressee thereof, or his agent or attorney, except to a telegraph or radio station employed to forward such radiogram to its destination, or in response to a subpoena issued by a court of competent jurisdiction, or on demand of other competent authority, shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, or imprisonment for not more than one year, or both, for each offense thereafter; provided, that this section shall not apply to the divulging or publication of the contents of any radiogram by the sender or addressee thereof.

Sec. 16. All stations shall give priority over all other radiograms to radiograms relating to ships in distress, shall discontinue all sending on hearing a distress signal, and, except when answering or aiding a ship in distress, shall refrain from sending until all radiograms relating to the ship or ships in distress shall have been completed.

Every coastal station and every station whose operation can interfere with the exchange of messages between ship and ship, or ship and coast is required, during the hours it is in operation, to listen in at intervals of not less than 15 minutes, and for a period of not less than 3 minutes, with the receiver tuned to receive messages on a wave-length of 600 meters or such



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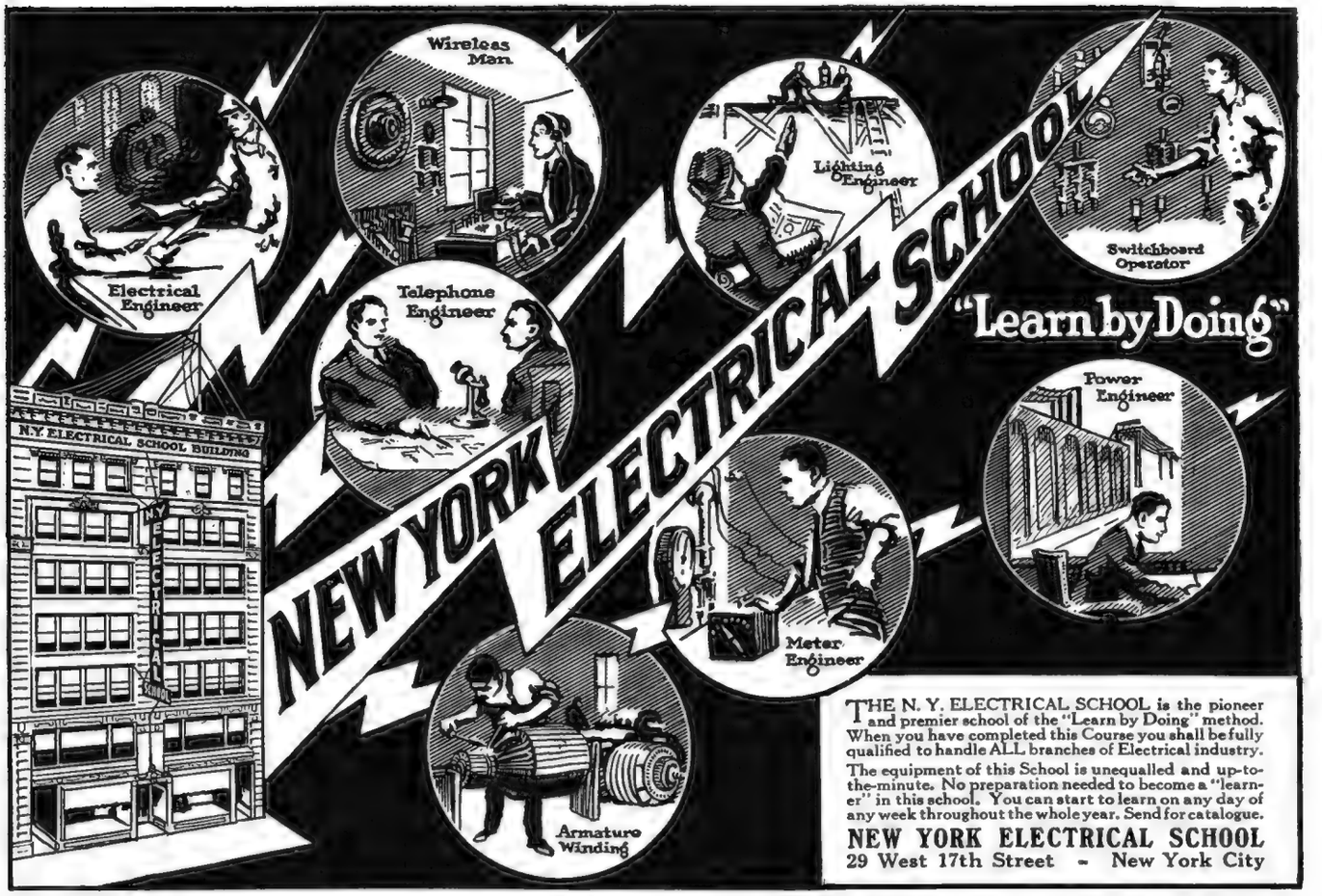
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other normal wave-length as may be required by future international conventions.

Sec. 17. When sending distress signals, the transmitter of a station on shipboard may be tuned to create a maximum of interference with a maximum of radiation. In all other circumstances, all stations shall use the minimum amount of energy necessary to complete any communication.

Every radio station shall use such transmitting apparatus that the energy is radiated in as pure and sharp a wave as practicable, and have a logarithmic decrement not greater than the limits which may be specified by the Department of Commerce, but the owner or operator of a station mentioned in Section 18 following shall not be liable to the penalties provided in Section 28 for a violation of the requirements of this paragraph unless such owner or operator shall have been notified in writing that the transmitter owned or used by him has been found, upon tests conducted by the Government, to be so adjusted as to violate said requirements, and opportunity given such owner or operator to adjust such transmitter so as to conform to said requirements.

Receiving apparatus shall be of such construction and so adjusted and used as to give the greatest practicable protection against interference.

Sec. 18. General amateur stations shall not use a transmitting wave-length exceeding 200 meters or a transformer input exceeding one kilowatt. Restricted amateur stations shall not use a transmitting wave-length exceeding 200 meters or a transformer input exceeding one-half kilowatt.

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(*Continued on page 699*)

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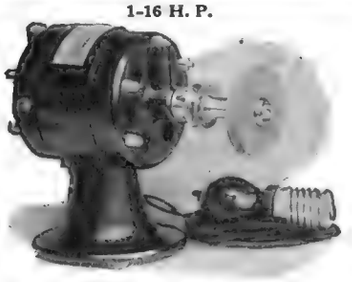

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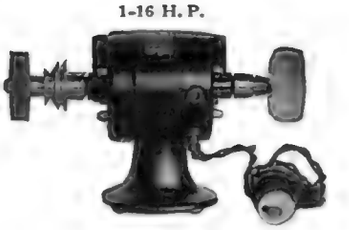

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any wave-length less than 600 meters and an amount of power not exceeding the limit which shall be specified in the license, provided the Secretary of Commerce is satisfied that such operation would not interfere with Government, commercial, coastal, or ship stations.

Sec. 19. The Secretary of Commerce may, in his discretion, grant licenses to experiment stations to permit the carrying on of tests with any amount of power or any wave-lengths, at such hours and under such conditions as will insure the least interference with the work of other stations.

Sec. 20. Commercial stations and technical and training-school stations shall not use a transmitting wave-length of 1800 meters nor any wave-length exceeding 600 meters unless it exceeds 1600 meters, except in special cases to be determined by the Secretary of Commerce. Such a station shall operate in such a manner as not to cause interference with Government stations or other commercial stations. Such a station shall not use any wave-length between 200 and 600 meters if operation at such a wave-length would in the opinion of the Secretary of Commerce cause interference with coastal or ship stations.

After the passage of this Act no license shall be granted to a commercial station permitting the use of a wave-length between 200 and 4000 meters, except when so far removed from Government or coastal stations that in the opinion of the Secretary of Commerce no interference can occur with Government or coastal communications.

In considering complaints of interference and in deciding whether the license of a station causing serious interference shall be revoked by the Secretary of Commerce, preference shall be given to stations communicating with ships or between points where other means of communication are not available.

Sec. 21. Every coastal station and ship station shall at all times be ready to send and receive messages and signals on such wave-lengths and of such wave character as are required by the existing or future international conventions, one of these wave-lengths to be considered as the normal sending and receiving wave-length of the station. Such stations may also use 1800 meters and such additional wave-lengths less than 600 meters as may be granted by the Secretary of Commerce. Every such station shall have its receiving apparatus so marked that the operator can quickly and conveniently adjust it to a receiving wave-length of 600 meters or other distress wave-length that may be designated by future international conventions.

Sec. 22. No licensed ship radio station when within fifteen nautical miles of a Government land station or a coastal station shall use a transformer input exceeding one kilowatt, nor when within five nautical miles of a Government land station or a coastal station, a transformer input exceeding one-half kilowatt, except for sending distress signals or signals or radiograms relating thereto.

The Secretary of Commerce may regulate or prohibit the use of the transmitters of stations on ship board in harbors within the jurisdiction of the United States, as he may deem necessary.

Sec. 23. No licensed land station in operation on the date of the passage of this Act within fifteen nautical miles from the Government receiving stations at the following points: Boston, Mass., Newport, R.I., Washington, D.C., Charleston, S.C., Key West, Fla., San Juan, P.R., Point Isabel, San Antonio, Laredo and El Paso, Texas, Fort Huachuca, Arizona, San Diego and San Francisco, Calif., North Head, Tatoosh Island and Bremerton, Washington, or from any Government station in Alaska, shall be licensed to change its equipment in any manner that will increase its interference with other stations, and no land station located within fifteen nautical miles of the Government receiving stations herein named, and not in operation on the date of the passage of this Act, shall be licensed for the transmission of public or commercial business by radio communication.

Sec. 24. At all important seaports and at all other places where coastal stations operate in such close proximity to Government stations that interference with the work of the Government stations cannot be otherwise avoided by the enforcement of this Act, such coastal stations as interfere with the receipt of radiograms by the Government stations concerned shall not use their transmitters during the first fifteen minutes of each hour, local standard time. The Secretary of Commerce may, on the recommendation of the Department concerned, designate the station or stations which may be required to observe this division of time. The Government stations for which the above-mentioned division of time may be establisht shall transmit radiograms only during the first fifteen minutes of each hour, local standard time, except in case of radiograms relating to vessels in distress.

Sec. 25. Whoever, including any person in the service of the Government, shall knowingly transmit or publish, or knowingly cause to be transmitted or publisht, any false or fraudulent distress radiogram, or who, when engaged in radio communication, shall transmit or publish, or cause to be transmitted or publisht, any other radiogram for the purpose of defrauding or deceiving the Government, shall be punished by a fine not exceeding two thousand dollars or imprisonment for not more than five years, or both.

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Sec. 26. No person shall use or operate any radio apparatus on a foreign ship when within the jurisdiction of the United States otherwise than in accordance with the provisions of Sections 14(a), 15, 16, 17 and 22 of this Act, and all the provisions of said sections and penalties thereto attaching are hereby made applicable to such apparatus; Provided, however, that in no other respect shall anything contained in this Act apply to apparatus on foreign ships, nor shall the restrictions of this Section or of any other Sections of this Act apply to public vessels of foreign governments otherwise than by a general proclamation of the President.

Sec. 27. The office of Director Naval Communications, establisht under the jurisdiction of the Navy Department, shall be charged with the accounting and payment of charges in connection with the settlement of international radio accounts as provided by the London Radiotelegraphic Convention of 1912, or as may be provided by future international conventions. The expenses involved in the settling of international radio accounts, not exceeding five thousand dollars per annum, shall be borne by the United States.

Sec. 28. In all cases of violation of any provision of this Act for which no penalty is otherwise prescribed, or of any regulation of the Secretary of Commerce, the Secretary of Commerce may impose a fine of one hundred dollars upon the owner of the apparatus by means of which such violation was effected, or a fine of twenty-five dollars upon the offending operator, or both, but such fines may be reduced or remitted by the Secretary of Commerce in his discretion; and in addition the Secretary of Commerce may, in his discretion, revoke the station license of such owner and revoke or suspend the license of such operator as provided in Sections 10 and 13 of this Act.

Sec. 29. The Secretary of Commerce shall have power to enforce the provisions of this Act by appropriate regulations through collectors of customs and such other officers as he may designate; and said Secretary shall also enforce

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the provisions of such international radio conventions as have been or may hereafter be ratified or adhered to by the United States, except that provisions thereof relating to Government radio installations shall be enforced by the Departments respectively controlling such installations.

The Secretary of Commerce may, upon application therefor, remit or mitigate any fine, penalty, or forfeiture provided for in this Act with the exception of penalties including imprisonment: Provided, that the penalties not involving imprisonment incurred in the Philippine Islands, may be remitted or mitigated by the Governor General and President of the Philippine Commission, and such penalties incurred in the Panama Canal Zone may be remitted or mitigated by the Governor of the Panama Canal on application therefor being made, in such manner and under such regulations as they may deem proper.

Sec. 30. Except as otherwise specifically provided in this Act, the provisions of this Act shall extend to all places subject to the jurisdiction of the United States. The several Courts of First Instance in the Philippine Islands and the District Court of the Canal Zone shall have jurisdiction of offenses under this Act committed within their respective districts, and of conspiracies to commit such offenses as defined by section thirty-seven of the Act to codify, revise, and amend the penal laws of the United States, approved March 4, 1909, and the provisions of said section, for the purposes of this Act, are hereby extended to the Philippine Islands and to the Canal Zone.

Sec. 31. The Act approved August 13, 1912, entitled "An Act to Regulate Radio Communication," is hereby repealed.

Such repeal, however, shall not affect any act done or any right accruing or accrued, or any suit or proceeding had or commenced in any civil cause prior to said repeal, but all liabilities under said laws shall continue and may be enforced in the same manner as if said repeal or modifications had not been made; and all offenses committed, and all penalties, forfeitures or liabilities incurred prior to the taking effect hereof, under any law embraced in, changed, modified, or repealed by this Act, may be prosecuted and punisht in the same manner and with the same effect as if this Act had not been past.

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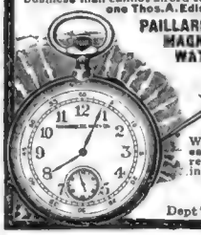

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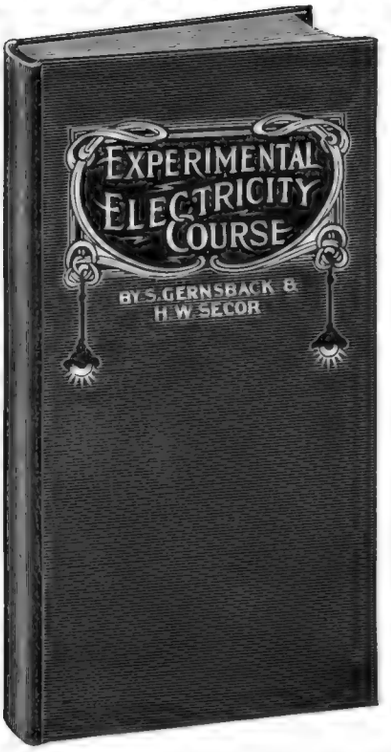

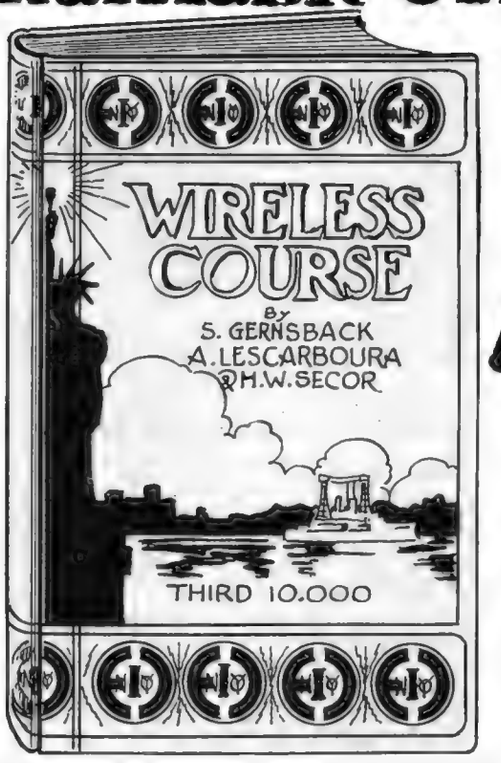

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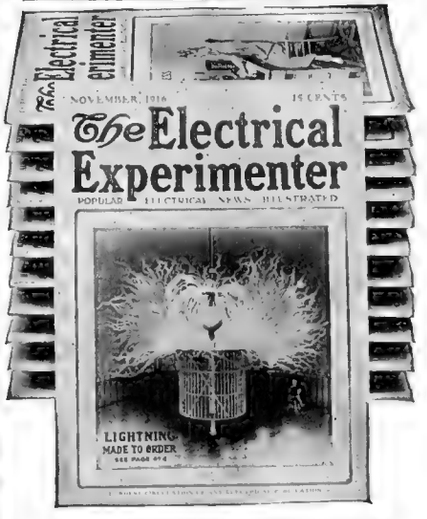

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FOR SALE—One receiving set, $8. Tunes to 4,000 meters. First money order brings set. Jack Beckton, Caro, Mich.

SALE OR TRADE—$18 Meccano, $8; $3.50 6 v. Dynamo, $2.50; $4 Hand horn, $2.50; Mirrorscope, $1; some sockets; switches, etc. All new. Want Tel-Radion, variables, etc. W. Kinney, 819 Main, Conneaut, Ohio.

FOR SALE—One-half kilowatt transformer and interrupter, price $6. James Butler, 26 Burlington St., Woburn, Mass.

WILL TRADE—600 stamps mounted in International Junior Album and Scott's Standard Catalog for "Brandes Superior Headset" or $5. Telephone Magneto Generator, $1.25; Battery Switchboard, $1.50; 12 Alger Books, $1; Simplex Typewriter No. 1, 85c. Arvine Day, 122 Hartson St., Syracuse, N.Y.

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FIRST $2.50 takes 1-inch E. I. Co.'s Spark Coil. In good condition. Wolf Farsen, 212 Brighton St., Tottenville, N.Y.

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EXCHANGE—1/10 H.P. D.C. Motor and 4 bar magneto, 6 v. 2 amperes. Want Crystaloi B.B., Mignon RCI or Tel-Radion. D. Gadberry, Wilmington, Ill.

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FOR SALE—One 4,000 meter loading inductance for oscillating Audion circuits. Price $3. Edward Law, Jr., 216 Sycamore St., Clarksburg, W.Va.

BARGAIN—Transcontinental set, magneto, 4 Edisons, $16. New F.C. Tel-Radion, $14. LeRoy Daniels, Litchfield, Mich.

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Matoon, Illinois.
November 21st, 1916.

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FOR SALE OR EXCHANGE—Remington Typewriter for two Audiotron Bulbs and long wave inductances or $10 cash. Have one-cylinder 1903 Oldsmobile Auto, may be converted into cycle-car, will trade for ½ K.W. Transformer and Condenser or equal value. Jack Hardy, Littleton, Mass.

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SALE OR EXCHANGE—United Wireless Carborundum Detector, 75c.; Buzzer, 20c.; 20 ohm Sounder, $1; 160 ohm Relay, $2. All new. Want Murdock 55 or Brandes Phones. J. Smith, Trout Run, Pa.

FOR SALE—Vest pocket camera, $3; Post card camera, $8; 4x5 Plate camera and outfit, $6. (Write) L. A. Madison, Kingman, Me.

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STAMPS—75 all different free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

MARCONI—We have a limited number of pictures of Guglielmo Marconi that are done in sepia on fine India paper. Fine for decorating your wireless room. Ten cents each postpaid. Experimenter Publishing Co., 233 Fulton St., New York City.

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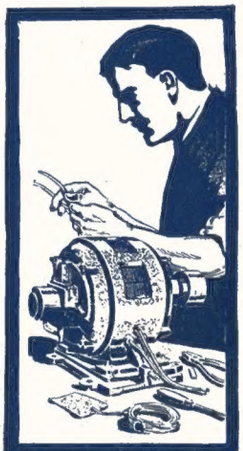

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